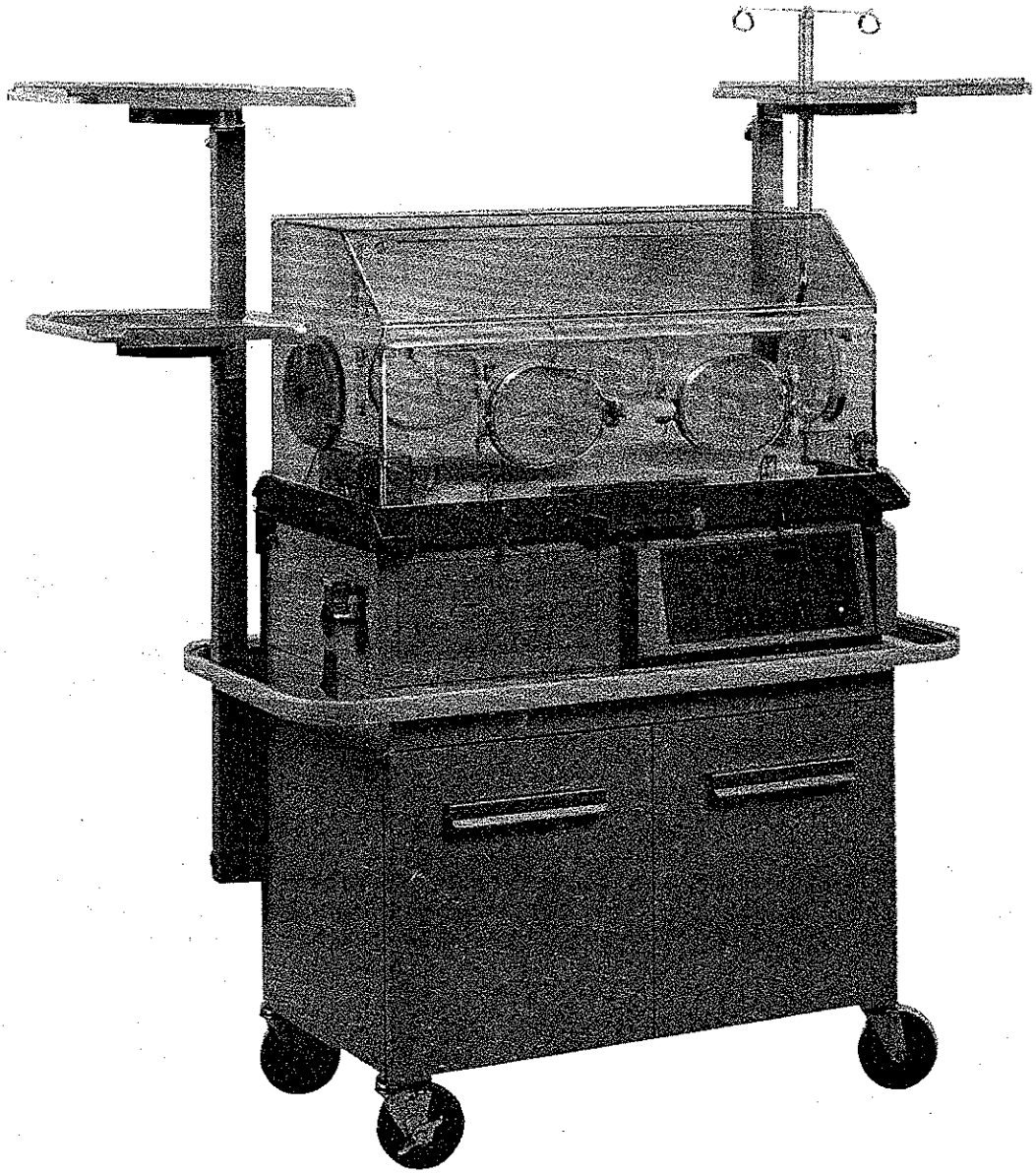
QT

Service Manual



ISOLETTE®

INFANT INCUBATOR

Models C100 and C200 and QT®

Includes: Hood and Shell Assembly, Models C100/200–2
Controller, Models C68–2/2E, C82–1/1E

Air-Shields Vickers Medical

LIMITED

WARRANTY

The product being described in this manual is warranted against defects in materials or workmanship for one year from the date of shipment from Air–Shields, Hatboro, with the following exceptions.

All consumable and disposable products are guaranteed to be free from defects upon shipment only.

Calibrations are considered normal maintenance and are not included in the 1 year warranty.*

During the warranty period any defective parts other than those listed above will be replaced at no charge to the customer. There will be no labor charge for replacing the parts within the continental U.S.

This warranty is rendered void and Air–Shields cannot be held liable for conditions resultant therefrom if:

1. Damage to the unit is incurred as a result of mishandling.
2. The customer fails to maintain the unit in a proper manner.
3. The customer uses any parts, accessories, or fittings not specified or sold by Air–Shields.
4. Sale or service is performed by an non–certified service/dealer agency.

This warranty is in lieu of all other warranties, expressed or implied, and Air–Shields shall in no event be liable for incidental or consequential damages including loss of use, property damage, or personal injury resulting from breach of warranty.

*The Accreditation Manual for Hospitals requires each piece of equipment is to be tested prior to initial use and at least annually thereafter. To comply with this standard, we recommend that you participate in our Preventive Maintenance Program during the warranty period. This service can be performed by certified technicians through our Product Service Group and authorized dealers.

SERVICE

For optimal performance, product service should be performed only by qualified service personnel. Product Service Group instrumentation specialists are located throughout the United States and are dispatched for required maintenance by calling 800–523–2404. Customers outside the U.S. should contact their local factory–authorized Air–Shields distributor for service.

Cat. No. 68 990 13–17
A 1 2 3 4 5 6 7 8 9
E 1 2 3 4 5 6 7 8 9

Tech Serv
1-800-445-3720

Printed in U.S.A., 12/82

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Air-Shields Vickers Medical
330 Jacksonville Road, Hatboro, PA 19040

PLEASE READ

Please check the A page for change information.

Since Air–Shields Vickers conducts a continuous product improvement program, circuit and component improvements are sometimes incorporated into equipment before they can be incorporated into the printed manuals. When this occurs, changed material is provided on separate sheets at the rear of the manual or under separate cover in the form of a change package. Changed material on each page of text is indicated by a vertical bar in the margin next to the changed material, as shown on the right.

THIS MANUAL CONTAINS PROPRIETARY INFORMATION. REPAIRS AND AUTHORIZED MODIFICATIONS SHOULD BE PERFORMED ONLY BY QUALIFIED SERVICE PERSONNEL TO MAINTAIN YOUR WARRANTY AND TO AVOID CREATING SAFETY HAZARDS. WE CANNOT ASSUME RESPONSIBILITY FOR ANY CONDITIONS AFFECTING THE PROPER OPERATION OF THIS EQUIPMENT WHICH MAY RESULT FROM UNAUTHORIZED REPAIR OR MODIFICATION.

NOTE ON REPLACEMENT PARTS

Some parts used in your equipment may be different than those which appear in the Parts List of this manual. This sometimes occurs due to difficulty in parts procurement, but does not alter the function of the equipment. Order the part listed in the Parts List.

NOTE: ALSO SEE PAGE 2.

LIST OF AVAILABLE MODIFICATION KITS

ITEM	DESCRIPTION	PART NO.
1	CONTROLLER MAXIMUM AIR TEMPERATURE (38.5 °C) RETROFIT KIT Changes maximum air temperature limit from 38.0 +/– 0.5 °C to 38.5 +/– 0.5 °C and the high air temperature alarm to 39.5 +/– 0.5 °C displayed temperature. The components supplied in this kit are identified in the applicable parts list (Sect. 6) by an (*) and reference designation as follows: R20 and R 60.	68 903 70
2	PROBE FAIL CORRECTION RETROFIT KIT Modifies the Controller to ensure that the AIR and SKIN digital displays blank if the air and skin temperature probe opens or shorts. The components supplied in this kit are identified in the applicable parts list (Sect. 6) by an (*) and reference designation as follows: C3, C9, CR1 and CR6.	68 903 71
3	DISPLAY DRIFT CORRECTION RETROFIT KIT Modifies the Controller to ensure the digital displays track to the actual temperature. The components supplied in this kit are identified in the applicable parts list (Sect. 6) by an (*) and reference designation as follows: C1, C4, C7, C10, CR9, R5, R6, R16, R17, R24 and R34.	68 903 72
4	LONG STEMMED CASTER RETROFIT KIT (WITH BRAKE) LONG STEMMED CASTER RETROFIT KIT (WITHOUT BRAKE) Reduces possibility of caster falling off of cabinet and reduces wear on caster bushing.	68 901 71 68 901 72
5	MATTRESS TRAY WARNING LABELS This kit provides the C100 and C200 Incubators with Mattress Tray Warning Labels. English Spanish French German	 68 902 78 68 902 79 68 902 80 68 902 81
6	REPLACEMENT KIT, PCB2, C100	68 905 74
7	REPLACEMENT KIT, PCB2, C200	68 905 75
8	REMOTE ALARM KIT, C100/200 Provides Controller with Remote Alarm Model, AM68–1, capability.	68 411 75

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TABLE OF DEFINITIONS AND SYMBOLS

TECHNICAL DEFINITIONS

Control Zone. The area between two planes10 and 15 cm above the mattress center and parallel to the mattress, measurement points being above the center points of the four quadrants of the mattress.

Incubator Temperature. Air temperature at a point 10 cm (4 in.) above and centered over the mattress surface.

Temperature Equilibrium. The condition reached when the average **Incubator Temperature** does not vary more than 0.2 °C over a period of one hour.

Temperature Overshoot. The amount by which **Incubator Temperature** exceeds average **Incubator Temperature at Temperature Equilibrium,** resulting from a change in control temperature.

Temperature Rise Time. The time required for the **Incubator Temperature** at center mattress to rise 10 °C.

Temperature Uniformity. The amount by which the average temperature at each of four points 10 cm (4 in.) above the mattress surface differs from the average **Incubator Temperature** at **Temperature Equilibrium.** The four points are the centers of four are as formed by lines that divide the width and length of the mattress surface.

Temperature Variability. The variability of the temperature at a fixed point in the incubator above the mattress that will be observed over a one–hour period after **Temperature Equilibrium** has been reached and all accesses remain closed.

NOTE, IMPORTANT, CAUTION, AND WARNING

NOTE: A Note is inserted in text to point out procedures or conditions which may otherwise be misinterpreted or overlooked. A Note may also be used to clarify apparently contradictory or confusing situations.

IMPORTANT: Similar to a Note but used where greater emphasis is required.

CAUTION: A Caution is inserted in text to call attention to a procedure which, if not followed exactly, can lead to damage or destruction of the equipment.

WARNING: A Warning is inserted in text to call attention to dangerous or hazardous conditions inherent to the operation, cleaning, and maintenance of the equipment which may result in personal injury or death of the operator or patient.

(Change 15)

SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

This manual provides instructions for installation, maintenance, and repair of the Air–Shields Isolette® Infant Incubator Model C100 and C200; it is intended for use only by trained, qualified service personnel. Instructions for the operator of the Incubators are provided in a separate operator's manual.

1.2 DESCRIPTION

The forced air circulation system of the Incubator permits stable temperature control, uniform heat distribution, humidification, effective isolation of the infant from airborne contaminants, and control of oxygen concentrations. Accessibility to the infant is provided by an Access Panel, Access Doors, and Iris Entry Ports. When the Access Panel is open, a curtain of warm air flows from beneath the front edge of the mattress toward the top of the Access Panel opening; this air shield minimizes the temperature drop within the hood environment.

On the Model C100, skin or air temperature control is selected by a front panel control. The Model C200 is equipped only for Air Temperature control. Instrumentation includes digital display(s) for temperature, LED's for relative indication of heater output, and a comprehensive visual and audible alarm system which includes an alarm test feature.

The C100/200–2 Series –02 is equipped with Oval Access Doors and a Mattress Deck with a continuously Variable Mattress Tilt Mechanism. The C100/200–2 Series –02 may be mounted on a Standard Cabinet Stand or an optional Vertical Height Adjustable (VHA) Stand.

1.3 ACCESSORIES

Accessories available for use with the Incubators are illustrated in Figure 1.1.

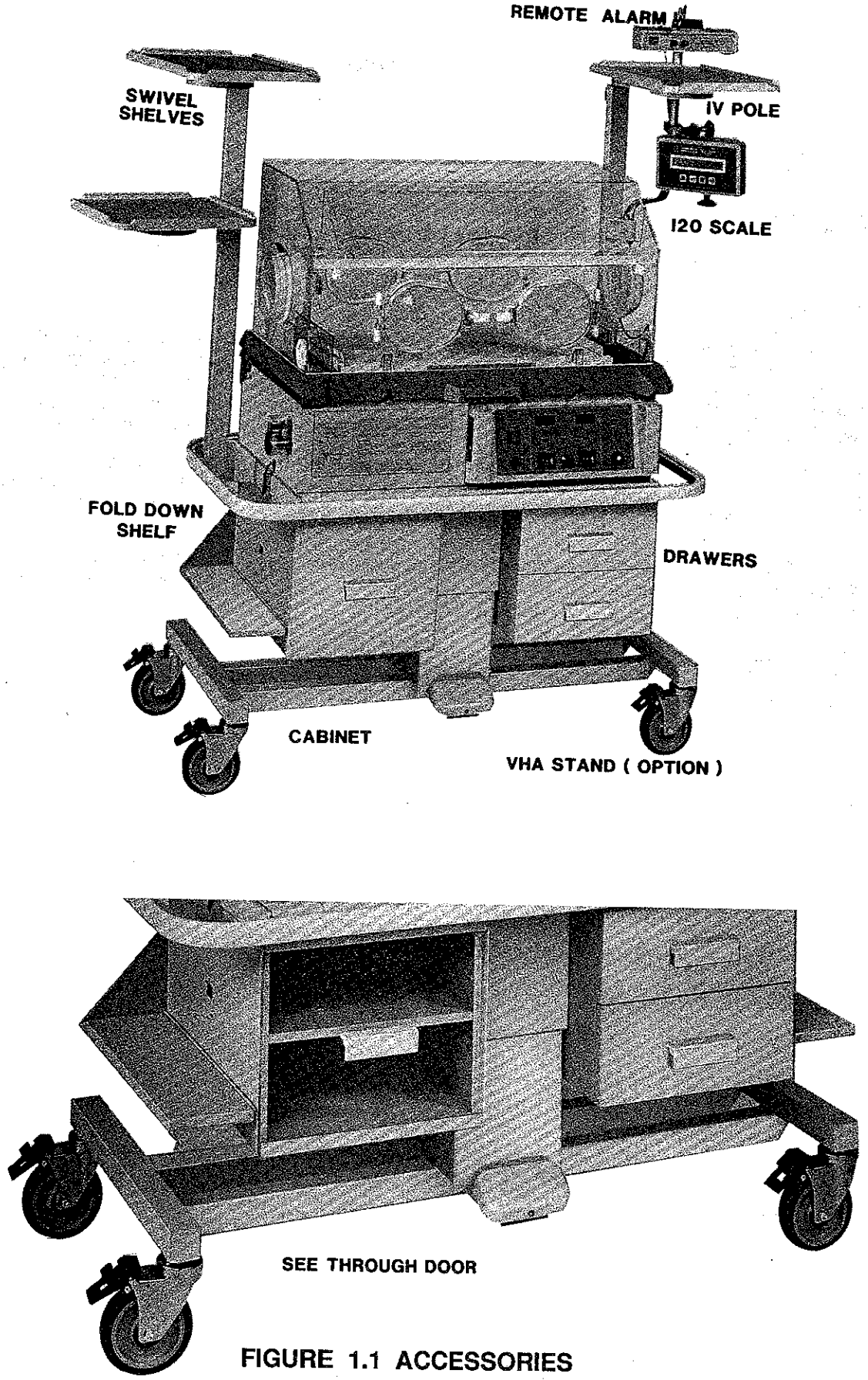

FIGURE 1.1 ACCESSORIES

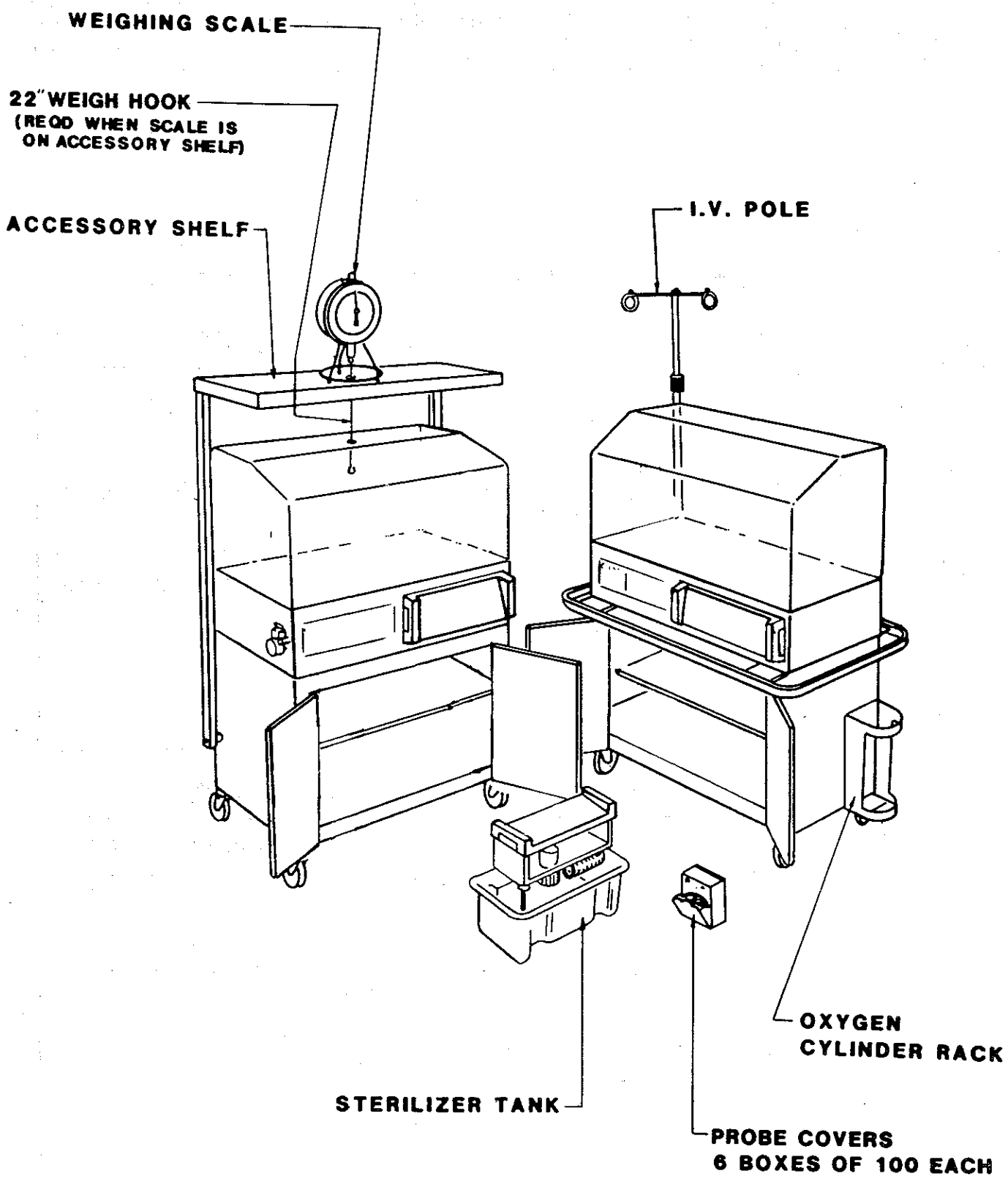

FIGURE 1.1 ACCESSORIES (continued)

1.4 MODEL IDENTIFICATION/SERIES CHANGE

The Air–Shields Isolette® Infant Incubator contains two data tags which list model identification and series number. One data tag is located on the side of the Incubator next to the probe and power cord connector panel; this data tag relates to the Hood and Shell Assembly excluding the Controller. The second data tag is located on the top of the Controller Chassis and relates only to the Controller. Example:

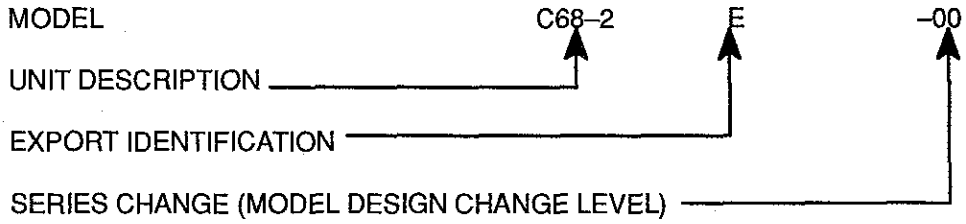

TABLE 1.1 SERIES CHANGE – C68–2 CONTROLLER

SERIES NO.	DESCRIPTION OF CHANGE	ITEMS/ASSEMBLIES AFFECTED
00	Original Design	None
01	Add Circuitry to accommodate Remote Alarm Model AM68–1	PCB2 68 351 71 changes to 68 351 72
02 and 03	SPR 149	Add 68 951 32 and 33
04	100V units changed from 350 to 385W 120V units changed from 350 to 396W 220/240 units changed from 350 to 328 to 396W	68 215 70, 71, 72, 80, 81 82 , 83 and 90

TABLE 1.2 SERIES CHANGE – C82–1 CONTROLLER

SERIES NO.	DESCRIPTION OF CHANGE	ITEMS/ASSEMBLIES AFFECTED
00	Original Design	None
01	Add Circuitry to accommodate Remote Alarm Model AM68–1	PCB2 68 351 75 changes to 68 351 76
02	100V units changed from 350 to 385W 120V units changed from 350 to 396W 220/240 units changed from 350 to 328 to 396W	68 217 70, 71, 72, 80, 81 82 , 83 and 90

TABLE 1.3 SERIES CHANGE – C100/200–2 HOOD AND SHELL ASSEMBLY

SERIES NO.	DESCRIPTION OF CHANGE	ITEMS/ASSEMBLIES AFFECTED
00	Original Design	None
01	Oxygen Limiter Filter Cover optional accessory	68 110 70, 78, 80
02	Oval Access Doors, Continuously Variable Mattress Tilt Mechanism	68 159 90, 91, 68 521 70

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SECTION 2
INSTALLATION

2.1 GENERAL

The Cabinet Stand, the Hood and Base Assembly, and the Guard Rail are shipped in separate cartons. When removing the equipment from the cartons, take care not to scratch or otherwise damage unprotected surfaces. Remove all packing materials from the shell assembly.

2.2 ASSEMBLY

2.2.1 INCUBATOR AND STANDARD CABINET STAND

Instructions for assembling each major assembly are provided in the shipping carton for that assembly. To assemble the major items (the Cabinet Stand, the Hood and Base Assembly, and the Guard Rail) proceed as follows:

1. If necessary, remove the Controller (Refer to Figure 4.1), attach the Guard Rail to the underside of the Base Assembly using the 6 bolts and lock nuts supplied (see Figure 2.2).

2. Place the Guard Rail and Base Assembly on the Cabinet Stand as shown in Figure 2.1.

3. Adjust the threaded clamps on each side of the Cabinet Stand for positive latching. The locking bar should be approximately horizontal when the clamp is engaged in retainer. Lock the clamps by rotating the locking bar to vertical position (Refer to Figure 2.1).

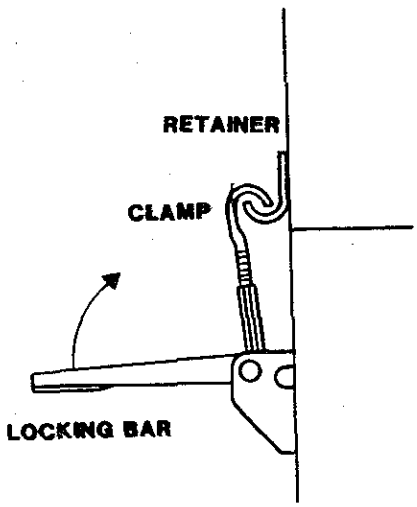


FIGURE 2.1 ADJUST THE LATCH AND LOCK THE CLAMPS

WARNING: The Incubator must be attached to the Cabinet Stand using the clamps provided. Failure to do so could result in the Incubator separating from the stand if sufficiently tilted, particularly with the hood open.

4. Install the Hood Assembly on the Base Assembly as shown in Figure 2.1.

5. Assemble the power cord bracket onto the Base Assembly as shown in Figure 2.1. Install the Controller.

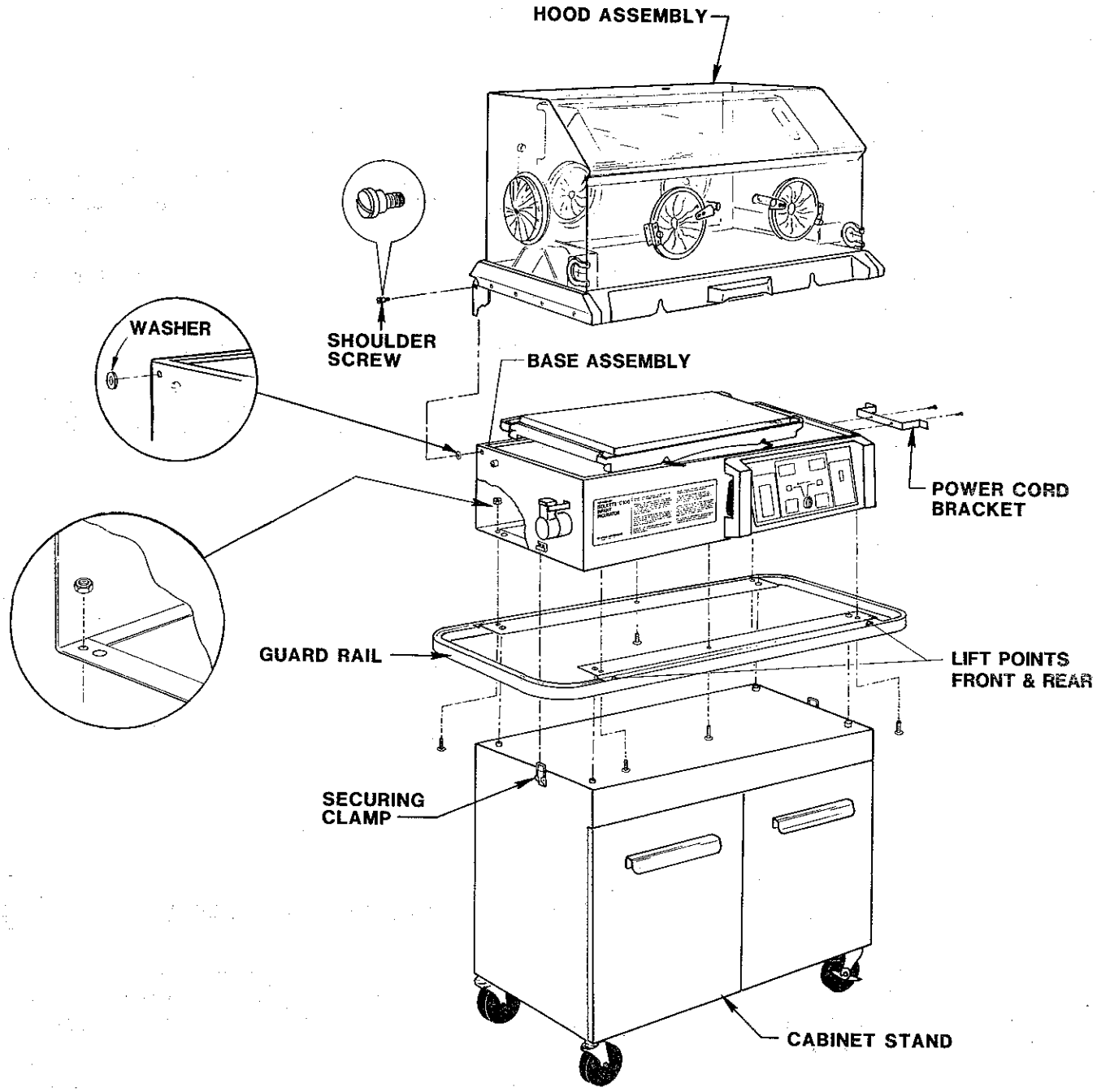


FIGURE 2.2 ASSEMBLY INCUBATOR AND STANDARD CABINET STAND

2.3 ASSEMBLY INCUBATOR AND VERTICAL HEIGHT ADJUSTABLE STAND (VHA)

1. If necessary, remove the Controller (Refer to Figure 4.1), attach the Guard Rail to the underside of the Base Assembly using the 6 bolts and lock nuts supplied (see Figure 2.3).

2. Place the Guard Rail and Base Assembly on the VHA (Vertical Height Adjustable) Stand as shown in Figure 2.3.

NOTE: If Cabinet or Drawer Modules are to be installed, they should be installed before the Incubator is placed on the VHA Stand.

WARNING: The Incubator must be attached securely to the VHA Stand using the clamps provided. Failure to do so could result in the Incubator separating from the stand if sufficiently tilted, particularly with the hood open.

WARNING: The VHA Stand is intended for use with Air–Shields Incubators which use the C100 Incubator Base Assembly. DO NOT use the VHA Stand with other Incubators. Incubator instability or tip over could result.

CAUTION: Refer to Figure 2.1 for lifting instructions.

3. Secure the Base Assembly to the VHA Stand using the clamp on each side of the VHA Stand.

IMPORTANT: Check to be certain Incubator is firmly secured to the stand at both ends. Do not place in service if not firmly secured.

4. Install the Hood Assembly on the Base Assembly as shown in Figure 2.3. Install the Controller.

5. Connect the interconnecting Power Cord from the VHA Stand to the Incubator ac POWER CORD Receptacle.

CAUTION: To comply with Underwriters Laboratories (UL) requirements, DO NOT connect the Incubator power cord directly to an ac wall socket when the Incubator is mounted on a VHA Stand. The power cord may be disconnected from the wall socket or damaged when the VHA Stand is raised or lowered. Always provide power to the Incubator using the Power Cord coming directly from the VHA Stand.

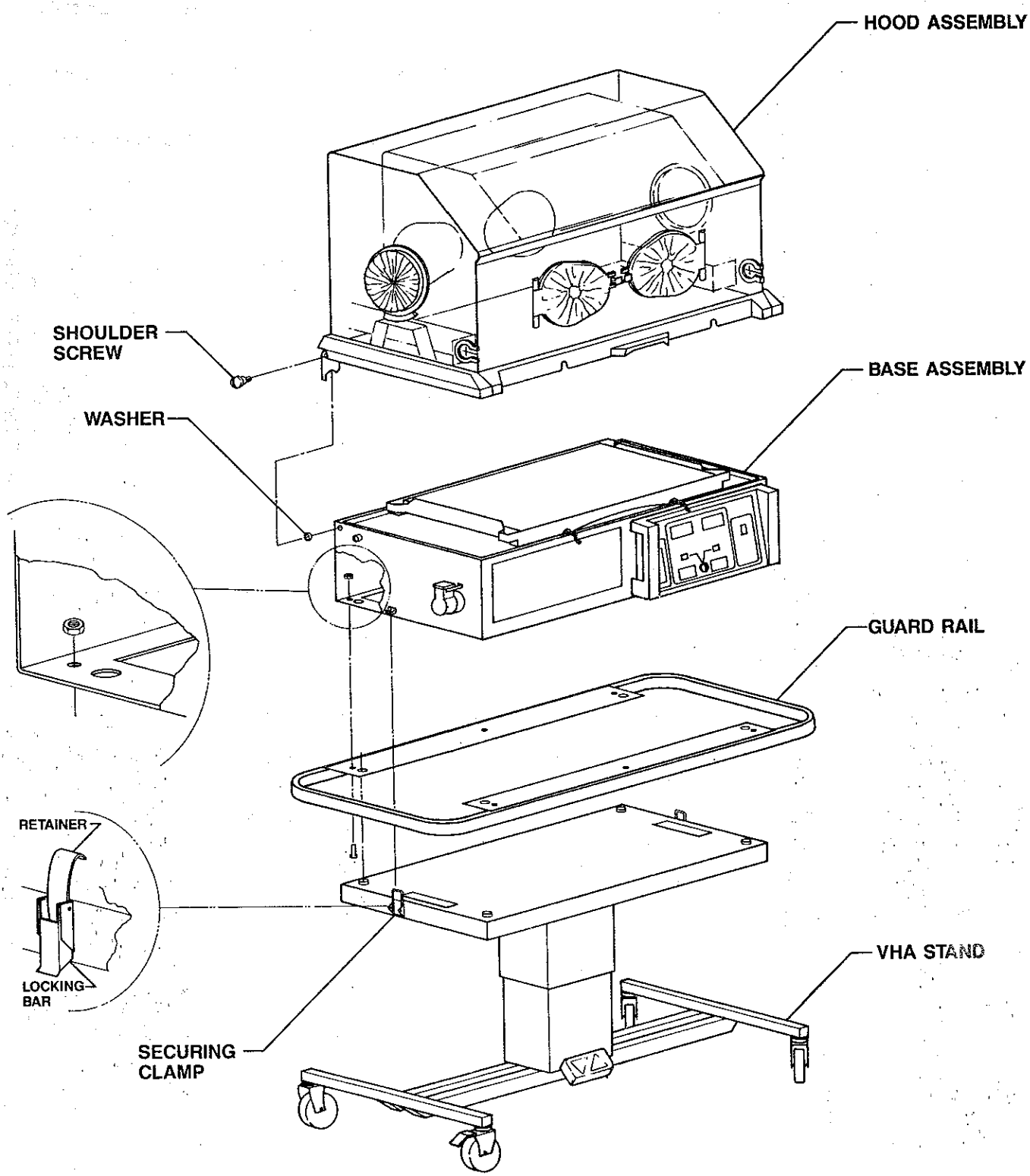


FIGURE 2.3 ASSEMBLY INCUBATOR AND VHA STAND

2.4 CLEANING

The Incubator should be cleaned as necessary using the procedures described in Section 4 of this manual.

2.5 OPERATIONAL CHECKOUT PROCEDURE

The operational checkout should be performed before the Incubator is first placed into use and after any disassembly for cleaning or maintenance.

1. **BEFORE CONNECTING THE INCUBATOR** to the power source, depress the POWER switch; the power failure alarm should sound, and the POWER FAIL indicator should light. This tests the operation of the power failure alarm circuit and ensures that the rechargeable battery that powers the circuit is in good condition. Depress the POWER switch a second time to silence the alarm.

2. **CONNECT THE POWER CORD.**

CAUTION: Make sure that the building power source is compatible with the electrical specifications of the Incubator. For proper grounding reliability, connect the power cord only to a properly marked 3–wire hospital–grade or hospital–use receptacle. Do not use extension cords.

3. **ON THE MODEL C100,** set the CONTROL MODE switch to the AIR position.

4. **DEPRESS THE POWER SWITCH.** When on, the switch is illuminated. When initially turned on, the power unit performs a 5–second self test; all alarm lamps light, the audible alarm is pulsed, and each temperature display (two in C100, one in C200) shows 3 eights (88.8). If any function does not occur, the unit requires service.

   Check all digits of Thumbwheel Switches for centering within their "window". If any digit does not center itself in its "window" with a positive "click" at all settings, replace the switch.

IMPORTANT: This test should be performed on a daily basis. The self test tests the lamps displays, and audible alarms, but does not completely simulate a functional failure.

5. **ADJUST THE AIR SET TEMP °C THUMBWHEEL SWITCH TO 34.0.** All four HEATER lamps should light, indicating full heater output.

NOTE: Allow the unit to operate while continuing the operational checkout.

6. **CHECK HOOD HINGE AND LATCH OPERATION** for proper positioning. Using the Hood Lift handle, slowly tilt the Hood back until the Hood Latch engages. Close the Hood by releasing the Hood Latch as shown in Figure 2.4.

FIGURE 2.4 HOOD RELEASE OPERATION

7. **CHECK ACCESS PANEL DETENT.** Rotate both latch releases inwardly and open the Access Panel as shown in Figure 2.5; the Air Curtain Cover should rise slightly as the Access Panel opens, and the detents should create a noticeable "drag" during initial movement of the panel. Pivot the Access panel to the full open position (hanging straight down).

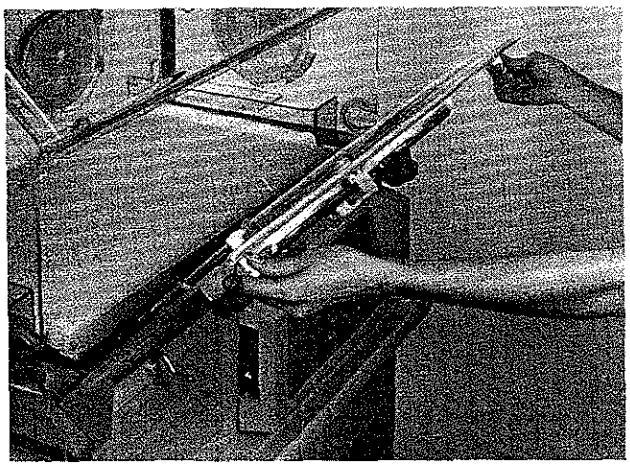


FIGURE 2.5 ACCESS PANEL OPERATION

8. **CHECK AIR CURTAIN COVER.** Remove Mattress Tray by lifting straight up to clear the rails on the hood baffles and then withdrawing through the front of the Incubator. Check that the rear curved edge of the Air Curtain Cover is retained by the 1/4" rod between the Mattress Tray rails and that the front edge is about 1" above the Main Deck.

WARNING: Do not lift the main deck or touch the heater when performing the following step. The heater can be sufficiently hot to cause burns.

9. **CHECK MAIN DECK** by pivoting the Air Curtain Cover to the vertical position and checking the Main Deck Retainer; the retainer should be positioned as shown in Figure 2.6. Lower the Air Curtain Cover and reinstall the Mattress Tray.

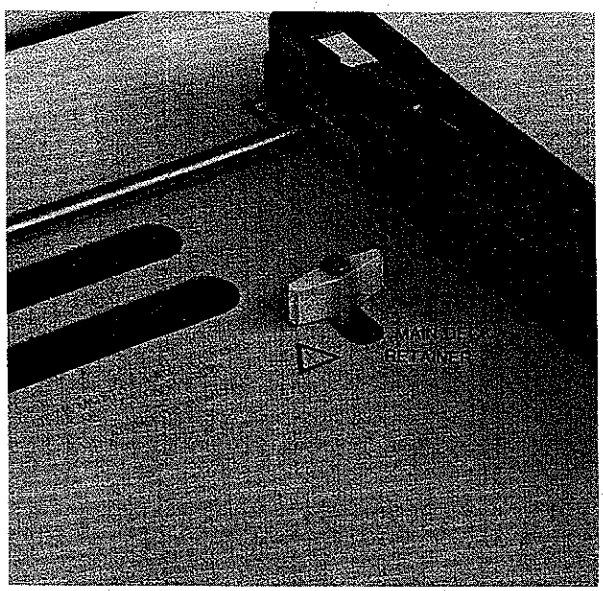


FIGURE 2.6 MAIN DECK RETAINER

10. **CHECK MATTRESS TRAY** by sliding it out to the fully extended position as shown in Figure 2.7. Apply firm pressure to the Mattress Tray; make sure it is properly supported by the rails and baffles to provide a firm infant platform.

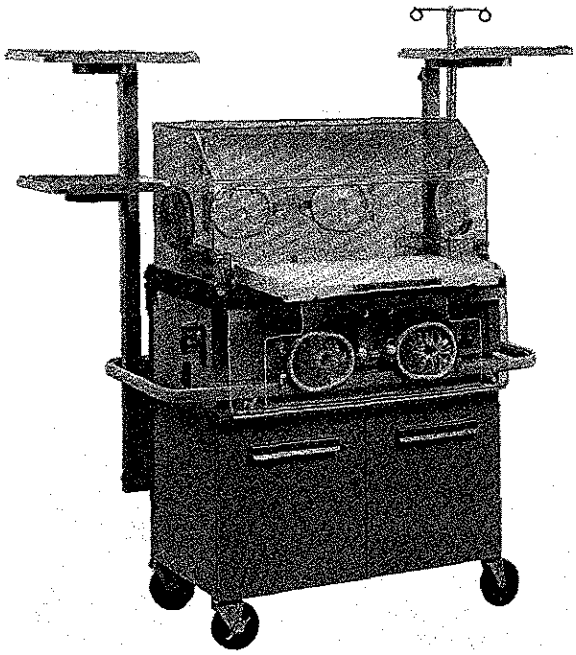


FIGURE 2.7 MATTRESS TRAY OPERATION

11. **CHECK ACCESS PANEL LATCHES** by closing the Access Panel and rotating both latches until fully engaged. Both latches must be fully engaged to avoid accidental opening of the Access Panel.

12. **CHECK ELBOW LATCH ACCESS DOORS.** Gently press the door release with an elbow, as shown in Figure 2.8. Each Access Door should swing open. Close the doors and check for proper latching.

13. **CHECK IRIS ENTRY PORTS.** Rotate the outer ring of each Iris Port; the iris should open and close as rotation is continued through 360°.

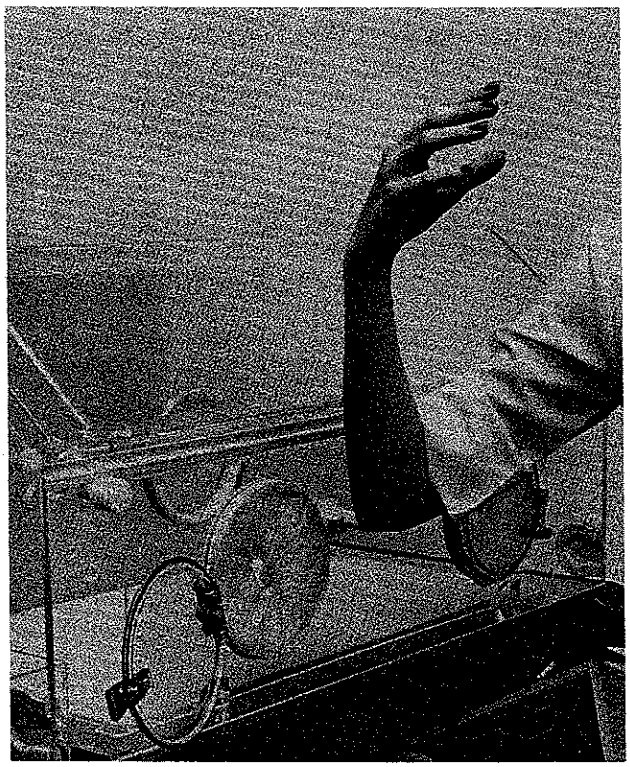


FIGURE 2.8 ACCESS DOOR OPERATION

14. **CHECK MATTRESS ELEVATORS.** Separately operate each Mattress Elevator by rotating handles downward as shown in Figure 2.9.

NOTE:

- These elevator levers are provided to permit the infant to be positioned in the Trendelenburg or Reverse Trendelenburg position. Do not elevate both ends of the mattress at the same time except for possible use during magnification x–ray procedures. Never leave the infant unattended while both elevators are raised.

- On C100/200 Series 01 Incubators the Hood cannot be opened when either Mattress Elevator is raised. ■

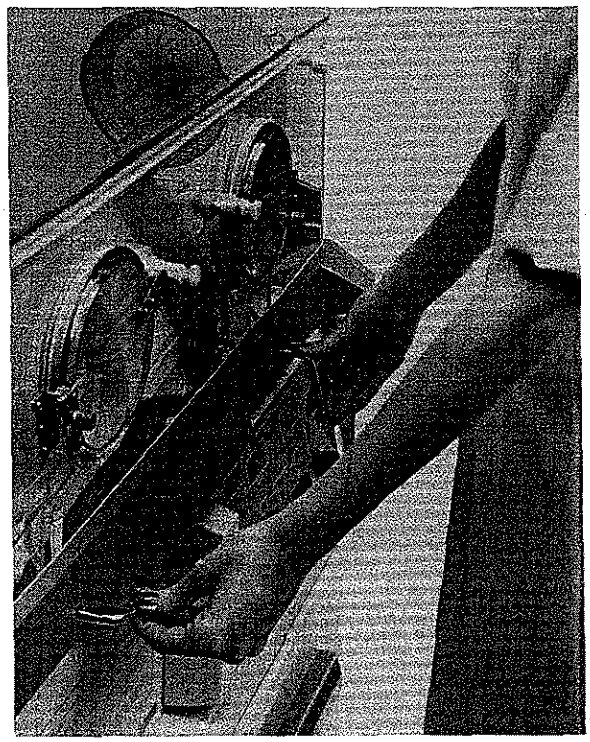


FIGURE 2.9 MATTRESS ELEVATOR OPERATION

WARNING: A dirty Air Intake Filter may affect oxygen concentrations and/or cause Carbon Dioxide build up. The filter must be checked on a routine basis and changed at least every three months.

15. **CHECK THE AIR–INTAKE MICROFILTER.** Loosen the two thumbscrews of the Air–Intake Filter Cover and remove the cover as shown in Figure 2.10. Inspect the microfilter; if visibly dirty it should be replaced. Refer to paragraph 4.2.3 for additional instructions.

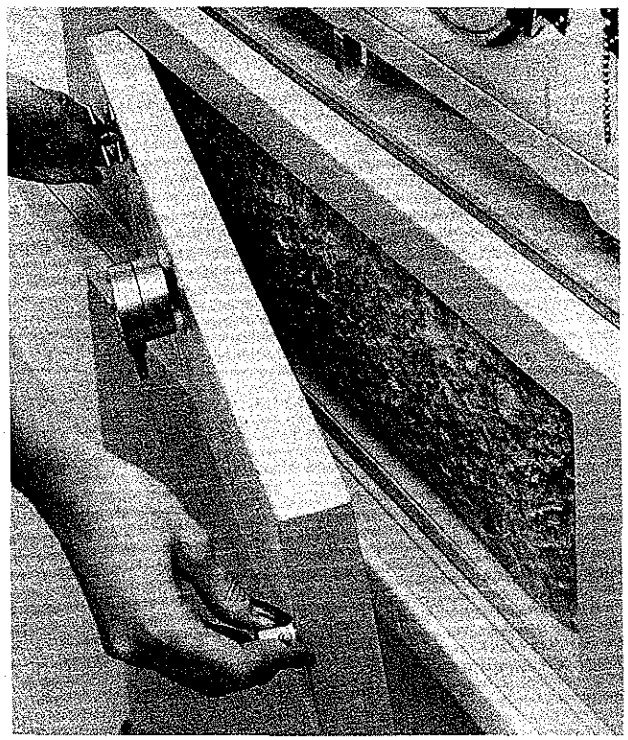


FIGURE 2.10 FILTER COVER REMOVAL

16. **CHECK THE OXYGEN INPUT VALVE FILTER.** The Oxygen Input Valve Filter Cartridge should be checked once every four months and replaced if the ends are gray or black. Refer to paragraph 5.4.8 for instructions on disassembly of the Oxygen Input Valve.

17. **CHECK AIR/OXYGEN SYSTEM** by introducing a carefully measured 8 LPM of oxygen, then monitoring levels within hood to verify that they reach the predicted level as indicated on the Filter Cover Assembly.

18. **CHECK AIR TEMPERATURE MODE OF OPERATION**. Place calibrated test thermometer 4 inches above center mattress. With all access openings closed, allow the Incubator to warm up to the thumbwheel setting (34.0); it should take approximately one hour or less. While the unit is warming up, suspend the auxiliary probe through the hole in the top of the Incubator Hood and position the patient probe* in the center of the mattress surface; do not connect the probe plugs to the receptacles. When the AIR TEMP °C Display has stabilized, the number of HEATER Indicator lamps illuminated will typically be reduced to no more than two. Check that the digital display remains within 0.5 °C of set temp for 15 minutes after stabilization. The test thermometer should read within 1.0 °C of the displayed temperature.

19. **CHECK AIR SET TEMP. ALARM** by setting the AIR SET TEMP °C thumbwheel first to 32.0 °C, then to 38.0 °C. An audible and visual alarm should activate at each setting after a 9 to 18 second delay and cancel when the setting is returned to the display reading.

* Model C100 only.

20. **CHECK AUXILIARY PROBE.** Insert the Auxiliary Probe connector into the AUXILIARY AIR PROBE receptacle. Set the AIR SET TEMP °C thumbwheel to 34.0 °C. When AIR TEMP °C Display has stabilized, the number of HEATER Indicator Lamps illuminated will typically be reduced to no more than two. Check that the digital display remains within 1.0 °C of set temp for 15 minutes after stabilization.

21.* **CHECK SKIN TEMPERATURE MODE OF OPERATION.** Connect the Patient Probe plug to the PATIENT PROBE Receptacle and set the SKIN SET TEMP °C thumbwheel to 36.0 °C. Set the CONTROL MODE Switch to the SKIN position. If the SET TEMP alarm actuates, depress the Alarm SILENCE/RESET Button. Allow the Incubator temperature to stabilize at 36 °C.

22.* **CHECK SKIN SET TEMP ALARM.** Leave the CONTROL MODE Switch in the SKIN position and set the SKIN SET TEMP °C thumbwheel to 37.5 °C, then to 34.5 °C. An audible and visual alarm should activate at each setting and cancel when the setting is returned to the display reading.

23.* **CHECK SKIN PROBE ALARM.** Leave the CONTROL MODE Switch in the SKIN position and disconnect the Patient Probe from the receptacle. The audible and visual alarms should activate, the SKIN TEMP °C digital display should go blank or flash, and the HEATER Indicator Lamps should all go on. When the Skin Probe is reconnected and after the SILENCE/RESET Button is depressed, the Incubator should return to normal operation.

WARNING: The Controller heater can be sufficiently hot to cause burns; avoid removing the Controller or touching the heater until the unit has been switched off for at least 45 minutes.

24. **CHECK AIR FLOW ALARM.** Set the POWER switch to OFF. Remove the Controller (Figure 4.1) from the Incubator. Remove the fan impeller from the fan motor shaft, and reinstall the Controller in the Incubator. Set the POWER switch to ON and wait for the end of the Auto–Test cycle (5 seconds). Within 5 minutes, the AIR FLOW indicator should flash, a pulsating audible alarm should sound, and all HEATER lights should go out. Reinstall the fan impeller and restore the Incubator to normal operating condition before proceeding.

25. **CHECK MAXIMUM AIR TEMPERATURE.** On the Model C100, position the probe end of the Patient Probe outside the Incubator (leave the CONTROL MODE Switch in the SKIN position). On the Model C200, set the thumbwheel switches to 39.9 °C. Allow the Incubator to heat. If the SET TEMP alarm actuates, depress the Alarm SILENCE/RESET Button.

    The Incubator should not heat above 38.5 +/– 0.5 °C, as indicated on the AIR TEMP °C display. The test thermometer located at center mattress should read less than 40 °C.

26. **CHECK HIGH TEMPERATURE ALARM.** Position probe end of auxiliary probe outside the Incubator, and a calibrated thermometer 4 inches above the center of the mattress. If the SET TEMP alarm actuates, depress the Alarm SILENCE/RESET Button. When the HIGH TEMPERATURE Alarm actuates, disconnect the auxiliary probe; the AIR TEMP °C display should read 39.5 +/– 1.0 °C (see note below). The calibrated thermometer located at center mattress should read within 1.3 °C of the displayed temperature.

OPERATIONAL CHECKOUT PROCEDURE C100/200–2 QT VERSION (Series –02) INCUBATORS

The Operational Checks described below should be performed in addition to the Operational Checkout Procedure described for the C100/200–2 Incubators.

CAUTION: HEAVY EQUIPMENT – To prevent injury or damage to the Incubator/Stand, two persons of sufficient strength are required to adequately control the Incubator when transporting.

CAUTION: Always lower the Incubator to its lowest position prior to transport for optimum stability.

NOTE: 39.5 +/– 0.5 °C in current production Incubators and Incubators which have been retrofitted for Air Temperature Limit of 38.5 °C. See Tables 6.9 and 6.11 for details relating to component changes.
* Model C100 only.

27. **CONNECT THE POWER CORD** of the VHA Stand to the ac power outlet. Turn on the Main Power Switch.

CAUTION: To comply with Underwriters Laboratories (UL) requirements, DO NOT connect an Incubator mounted on a VHA Stand directly to an ac wall socket. Always provide power to the Incubator using the Power Cord coming from the VHA Stand.

CAUTION: Make sure the building power source is compatible with the electrical specifications shown on the rear center column of the VHA Stand. For proper grounding reliability, connect the power cord only to a properly marked 3–wire hospital grade receptacle. Do not use extension cords.

28. **CHECK ACCESS DOOR LATCH.** Press the door release of each Access Door simultaneously (Figure 2.11). Each Access Door should swing open. Close the doors and check for proper latching and quietness.

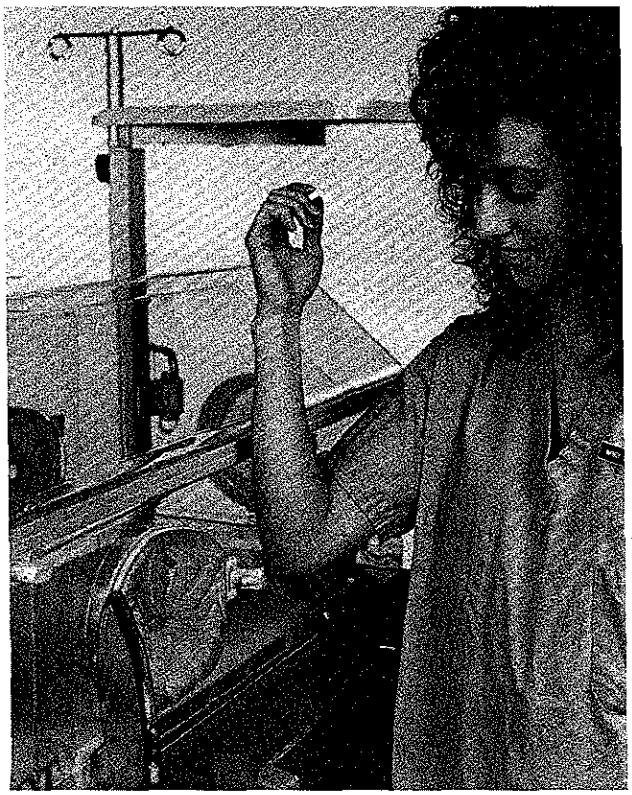


FIGURE 2.11 ACCESS DOOR OPERATION C100/200–2 QT VERSION

29. **CHECK MATTRESS ELEVATORS.** Rotate the right mattress Elevator Handle (Figure 2.12) clockwise until it stops. The right end of the mattress should be at a 9 degree angle. Rotate the handle counterclockwise until it stops. The mattress should be level. Repeat the procedure using the left mattress Elevator Handle.

WARNING: Do not attempt to raise the Hood when the mattress is raised.

IMPORTANT: Be sure that all the screws that secure the Elevator Tilt Mechanism to the Deck are fully tightened to ensure Mattress Tray stability.

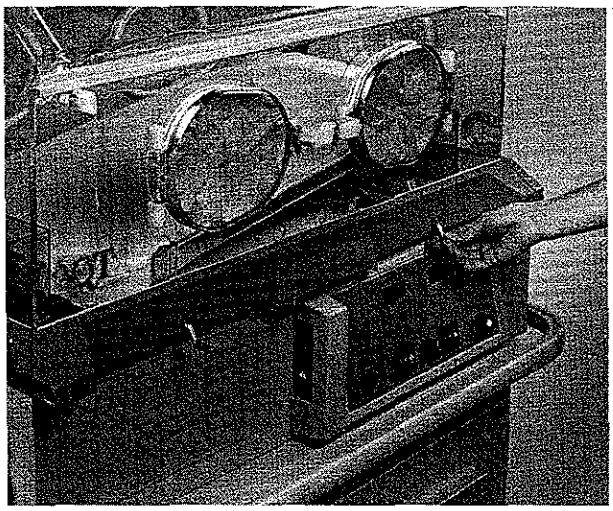


FIGURE 2.12 MATTRESS ELEVATOR OPERATION C100/200–2 QT VERSION

NOTE: These Elevator Handles are provided to permit the infant to be positioned in the Trendelenburg or reverse Trendelenburg position. Do not elevate both ends of the mattress at the same time except for possible use during magnification X–ray procedures. Never leave the infant unattended while both elevators are raised.

30. **CHECK THE VHA STAND (OPTION).** Depress the right portion of the VHA Stand Up/Down Switch to raise the stand to maximum height. Depress and hold the left portion of the VHA Stand Up/Down Switch to lower the stand to the minimum height. Readjust to desired height.

> **WARNING: Always place one hand on the Incubator for support when adjusting the height to prevent losing balance.**

CAUTION: Always reposition any phototherapy lamps prior to adjusting Incubator height.

31. **CHECKOUT IS COMPLETE.** Disconnect and store the Auxiliary and Patient Probes.* If the Incubator is to be used, set the CONTROL MODE Switch* to the AIR position and leave the Incubator running until ready for use. If it is not going to be used it may be shut off.

* Model C100 only.

SECTION 3
TECHNICAL INFORMATION

3.1 SPECIFICATIONS

Specifications for Incubator Models C100 and C200 are provided in Table 3.1. All specifications are subject to change without notice.

TABLE 3.1 SPECIFICATIONS

CONTROLLER POWER REQUIREMENTS:

Model C68–2	110/120Vac, 50/60 Hz, 396W
Model C68–2E	220/240Vac, 50/60 Hz, 328W to 396W
	100Vac, 50/60 Hz, 385W
Model C82–1	110/120Vac, 50/60 Hz, 396W
Model C82–1E	220/240Vac, 50/60 Hz, 328W to 396W
	100Vac, 50/60 Hz, 385W

CHASSIS LEAKAGE CURRENT 100/110/120 V Units ..... 100 µA or less
220/240 V Units ..... 500 µA or less

ALARMS:

Air–Flow	Actuated by fan failure or a short–circuited Air Flow probe.	
Probe	Actuated by a defective Air, Skin* High Temperature or Auxiliary probe or if the Skin* Temperature probe is disconnected when operating in Skin* Mode. Also actuated by an open–circuited Air Flow probe when the temperature sensed below deck is greater than 30 to 31 °C.	
High Temperature	Actuates if Air Temperature sensed below deck rises above 39.5 +/– 1 °C. (See Note below)	
Set Temperature (SET TEMP)	Actuates if Skin* or Air Temperature fluctuates from set temperature as follows:	
	Skin Temperature*	+1.0 +/– 0.3 °C
		–1.0 +/– 0.3 °C
	Air Temperature	+1.5 +/– 0.5 °C
		–3.0 +/– 0.5 °C
Power Failure Alarm (POWER FAIL)	An alarm which is actuated if primary power to the Incubator fails or the power cord is accidentally disconnected from the wall receptacle or the Incubator.	

* Model C100 Only.

NOTE: 39.5 +/– 0.5 °C in current production Incubators and Incubators which have been retrofitted for Air Temperature Limit of 38.5 °C. See Tables 6.9 and 6.11 for details relating to component changes.

Change 14

TABLE 3.1 SPECIFICATIONS (CONT.)

ALARM SILENCE/RESET Switch

Silence ..... Silences the set temp audible alarm for 12 to 15 min; alarm silence is automatically over–ridden if a subsequent alarm occurs within the period of silence.

Reset ..... Cancels High Air Temp., Air Flow or Probe Alarm if alarm condition no longer exists

TEMPERATURE CONTROL RANGES:

Air Temperature Mode ..... 20 °C to 38 °C +/– 0.5 °C***

Skin Temperature Mode* ..... 34 to 37.9 °C

TEMPERATURE RISE TIME** ..... 45 minutes or less

TEMPERATURE VARIABILITY** ..... 0.2 °C

TEMPERATURE OVERSHOOT** ..... 0.5 °C maximum

TEMPERATURE UNIFORMITY** ..... +/– 1°C

CORRELATION OF INDICATED AIR TEMPERATURE TO ACTUAL INCUBATOR TEMPERATURE** (after Temperature Equilibrium** is reached) ..... 1°C

CORRELATION OF INDICATED AIR TEMPERATURE TO SET TEMP.
(after Temperature Equilibrium** is reached):

Air ..... +/– 0.5 °C of set temperature up to 38 °C***

Skin* ..... +/– 0.3 °C of set temperature up to 37.9 °C

OXYGEN CONCENTRATION RANGE ..... 20.9 to 70%

HUMIDITY ..... Typically between 50 and 60% with water in humidity reservoir

NOMINAL DIMENSIONS:

Height ..... 137 cm (53–3/4")

Depth ..... 56 cm (22")

Width ..... 116 cm (45.7")

MATTRESS TILT

Trendelenburg/Reverse Trendelenburg ..... 0 ± 9°

NOMINAL WEIGHT ..... **76 Kg (168 lbs.)**

NOISE LEVEL WITHIN HOOD ENVIRONMENT ..... 60 dBA maximum with 50 dBA or less ambient

AIR VELOCITY OVER MATTRESS ..... Does not exceed 10 cm/sec (20ft/min) within Control Zone**

* Model C100 only. ** Refer to Table of Definitions and Symbols. *** 38.4 °C +/– 0.4 °C in current production Incubators and Incubators that have been retrofitted for Air Temperature Limit of 38.5 °C.

Change 15

TABLE 3.2 SPECIFICATIONS VHA STAND (OPTION)

Power Requirements (including Incubator)	120V, 10%, 60Hz 635W
	220V, 10%, 50Hz 562W
	240V, 10%, 50Hz 600W
Chassis Leakage Current (120V units)	less than 100 µA
(220V units)	less than 500 µA
(240V units)	less than 500 µA
Height	23 3/4" (60.3 cm) to 32 1/4" (81.9 cm)
Depth	with Guard Rail 22" (55.8 cm)
	without Guard Rail 21" (53.34 cm)
Width	with Guard Rail 45 1/2"(115.6 cm)
	without Guard Rail 37" (94 cm)
Weight	210 lbs (95.2 kg)
Weight (with Incubator mounted)	310 lbs (140.6 kg)
Variable Mattress Height	34 1/2 " (87.6 cm) to 43" (109.2 cm)
Maximum Weight on the Accessory Shelf	51 lbs (23.2 kg)

3.2 THEORY OF OPERATION

3.2.1 GENERAL

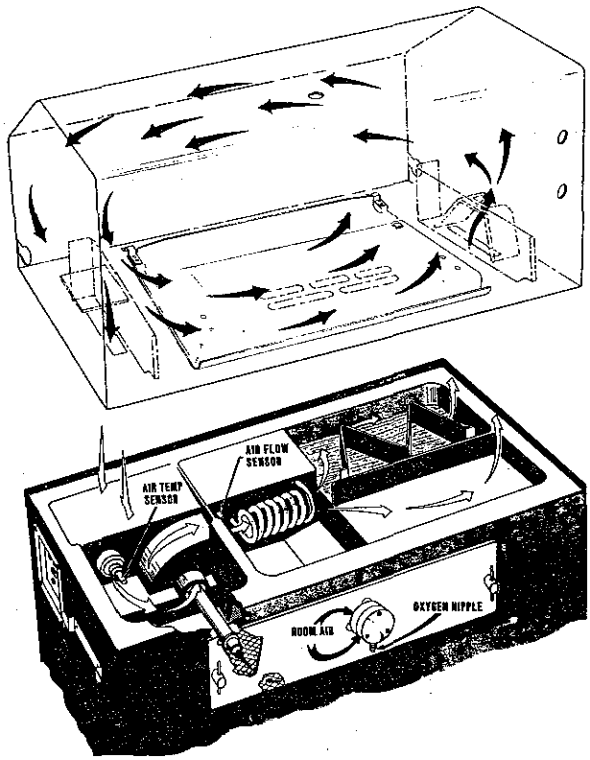
This section contains a system functional description for the Isolette® Infant Incubator, Models C100 and C200 and detailed theory of operation for the Controllers.

3.2.2 SYSTEM FUNCTIONAL DESCRIPTION

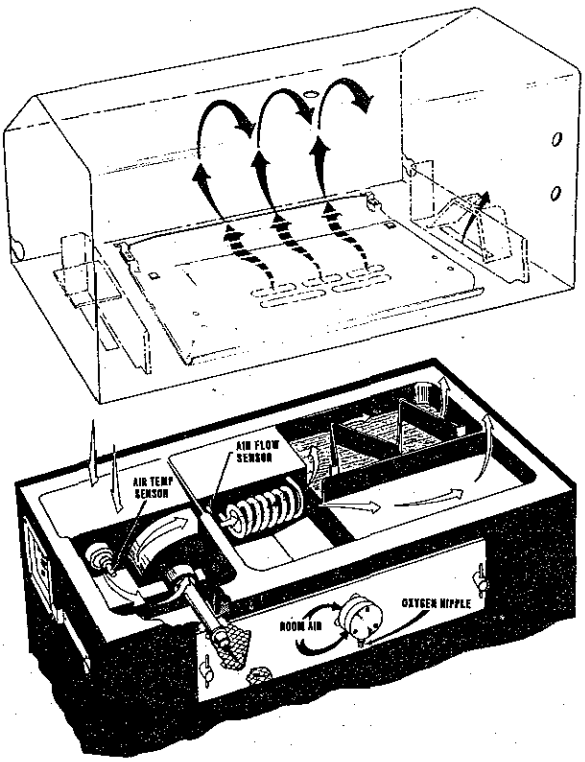
The control of temperature, humidity and oxygen concentration is achieved by means of the forced air circulation system as shown in Figure 3.1. A controlled volume of room air (approximately 35 lpm) is drawn through the air/oxygen intake filter by means of the motor driven impeller on the control unit. Supplemental oxygen, which is introduced through the Oxygen Input Valve on the filter cover, displaces a portion of room air to maintain the total gas intake (including oxygen) at 35 lpm. Since the amount of room air is controlled by the impeller/filter characteristics and the amount of oxygen is controlled by the flowmeter setting, predictable oxygen concentration within the incubator can be attained. When oxygen flow exceeds 8 lpm, a valve within the oxygen inlet housing is activated to restrict air intake so that higher oxygen concentrations can be achieved without excessive oxygen flow. At 12 lpm maximum air intake restriction is achieved.

In addition to drawing fresh, filtered air into the Incubator, the impeller provides for the internal recirculation at a much greater flow than that of the fresh gas inflow. The total flow of fresh plus recirculated air is directed past the air flow sensor and around the heater with a predetermined portion being directed over the humidity reservoir for humidification. When the Access Panel of the Hood is closed, the Air Curtain Cover is closed and all the air enters the infant compartment up through the slot at one end of the main deck as shown in Figure 3.1. After circulating within the infant compartment, the air is then recirculated down through the slot in the other end of the main deck, past the temperature sensing probe, which encapsulates the air temperature control thermistor and a high air temperature alarm thermistor, and back to the impeller. When the Access Panel of the Hood is open, the Air Curtain Cover is raised permitting a portion of the air to flow upward past the opening (Figure 3.1) creating a warm air shield which minimizes the drop in Incubator temperature.

(Change 16)



AIR CIRCULATION WITH INCUBATOR DOOR CLOSED



AIR CIRCULATION WITH INCUBATOR DOOR OPEN

FIGURE 3.1 AIR/O_2 CIRCULATION SYSTEM

3.2.3 TEMPERATURE CONTROL

In the Model C100, Incubator temperature is regulated using either Incubator air or infant's skin temperature as the controlling parameter; the desired mode is selected by a front panel switch. The Model C200 provides only air temperature control. In either mode of operation, the heater output is proportional to the amount of heat required to maintain the desired temperature, and the relative amount of heat being provided is indicated by the number of illuminated HEATER output lamps on the front panel. Changes in the number of lamps illuminated indicate the amount of power required to maintain a given temperature. During skin temperature control, Model C100 provides an indication of the degree of the infant's dependency upon the temperature of its environment to maintain body temperature. Each mode of operation is described below.

AIR TEMPERATURE MODE (MODELS C100 AND C200). In this mode of operation, the air temperature can be maintained from 20 to 38 °C as selected by the AIR SET TEMP °C thumbwheel switch on the front panel. The Incubator temperature is monitored by a probe located below deck and compared with the thumbwheel settings. The information from this probe is supplied to the heater control circuitry which proportions the heater output to maintain the thumbwheel setting. Actual air temperature is displayed on the Air Temperature Display. A second sensor within the air temperature probe serves as a backup to limit the temperature sensed below deck to between 39.0 and 40.0 °C; at this temperature an alarm is activated and the heater is shut off.

If desired, an auxiliary probe can be used to monitor and control the Incubator air temperature. This probe is suspended above the mattress through the weighing scale hole and plugged into a special receptacle on the side on the Incubator. When plugged in, the primary air temperature probe is disconnected, but the backup sensor within the primary temperature probe remains connected. Thus, the auxiliary probe becomes the controlling element for the air temperature.

In the Air Temperature mode of operation, the infant's temperature will be a function of the air temperature and the infant's ability to establish and maintain its own temperature. A small infant, or one with underdeveloped homeostatic control, may not be able to maintain a stable temperature at the optimum level.

SKIN TEMPERATURE MODE. (MODEL C100). In this mode of operation, the infant's skin temperature can be maintained at a temperature from 34 to 37.9 °C as selected by the SKIN SET TEMP °C thumbwheel switch on the front panel. A temperature sensing probe is attached directly to the infant's skin; the information from the probe is supplied to the heater control circuitry which proportions the heater output to maintain the skin set temperature. The air temperature set temp does not control air temperature while in the skin temperature mode, but actual air temperature is still displayed. The air temperature probe (or a properly installed auxiliary probe) still limits the air temperature to a maximum of 38.5 °C. If the CONTROL MODE Switch is set to the Air Temperature mode while the skin probe remains connected, the Skin Temperature display will continue to display actual skin temperature, but will not control. If the probe is disconnected from its receptacle at any time (Skin mode of operation), the Skin display blanks and an alarm is activated. The backup sensor within the Air Temperature probe remains in the circuit to limit maximum air temperature to 40 °C.

3.2.4 ALARMS

The Incubator is equipped with a system of alarms and temperature protection devices. Alarm indications are provided for power failure, inadequate air flow, probe failure, high temperature, and variation from set temp. Each time the unit is turned on, the unit is automatically stepped through an alarm check sequence to verify proper alarm function. After the automatic alarm check is made, the low set temp alarm is disabled for about 60 minutes, or until the temperature reaches set temp whichever occurs first. Each of these alarms is described below.

AIR FLOW ALARM (MODELS C100 AND C200). A sensor located below deck in the normal air path of the fan controls this alarm. If air flow stops due to a fan failure, the temperature of the self–heated sensor rises causing the AIR FLOW alarm on the front panel to flash and produces a pulsating audible tone. This alarm is non self–resetting and cannot be canceled by the Alarm SILENCE/RESET Button until the alarm condition is corrected. A short–circuited air flow sensor failure will also actuate the alarm within 9 to 18 seconds of the occurrence of the failure.

HIGH TEMPERATURE ALARM (MODELS C100 AND C200). A second sensor within the Air Temperature Probe sounds this alarm if the sensed temperature exceeds 39.5 +/– 1°C*. A high temperature alarm is indicated by a flashing light and a continuous audible tone. This alarm is non self–resetting and cannot be canceled by the Alarm SILENCE/RESET Button until the alarm condition is corrected.

PROBE ALARM. Circuitry is provided to monitor the air, skin (C100) and high temperature sensors for short–circuited, open–circuited, or disconnected conditions and the air flow sensor for open condition.

* 39.5 +/– 0.5 °C in current production Incubators and Incubators which have been retrofitted for Air Temperature Limit of 38.5 °C. See Tables 6.9 and 6.11 for details relating to component changes.

In the Model C100 Incubator, an indicator light flashes and an audible alarm sounds within 9 to 18 seconds to indicate a defective air temperature, skin temperature or auxiliary sensor or an open–circuited air flow sensor (see IMPORTANT). The probe alarm is also actuated if the skin temperature probe is disconnected while in the Skin Mode.

The Model C200 Incubator is equipped only for air control; therefore, no skin probe alarm is provided. The probe alarm is actuated to indicate a defective air temperature or auxiliary sensor or an open–circuited air flow sensor (see IMPORTANT).

IMPORTANT: The probe alarm will be actuated within 9 to 18 seconds if the air flow sensor is open–circuited and the temperature sensed below the mattress deck is greater than approximately 30 °C; however, if the temperature sensed below the mattress deck is less than approximately 30 °C, the alarm will not be actuated. During warm–up, it can take anywhere from 15–30 minutes before the alarm actuates, depending on the temperature set point and ambient room temperature. The "probe alarm" indicating an open–circuited air flow sensor will not occur if the set point temperature is below 29 °C.

In either Incubator, if a probe shorts (except for the air flow probe), it will appear as a high set temp violation, and the set temp alarm will light. This alarm is not self–resetting and cannot be canceled by the Alarm SILENCE/RESET Button until the alarm condition is corrected. If a probe alarm occurs simultaneously with a set temp alarm, a shorted probe is probably the true cause of the alarm, since a shorted probe will appear as a high temperature condition.

SET TEMP ALARM. The Set Temp alarm is actuated if skin* or air temperature fluctuates from set temperature as follows:

*Skin Temperature	+1 +/– 0.3 °C
	–1 +/– 0.3 °C
Air Temperature	+1.5 +/– 0.5 °C
	–3.0 +/– 0.5 °C

A temperature below the set temp is indicated by a flashing light, a pulsating audible tone, and a low temperature reading; a temperature above the set temp is indicated by a flashing light, a continuous audible tone, and a high temperature reading. If a set temp alarm occurs simultaneously with a probe alarm, a shorted probe is probably the true cause of the alarm, since a shorted probe will appear as a high temperature condition.

The set temp alarm is self–resetting; that is, if the alarm condition is corrected, the audible alarm is automatically silenced and the light is turned off.

The audible set temp alarm can be silenced by depressing the SILENCE/RESET Button; the activation of other audible and visual alarms will not be affected by use of the 15 minute audible alarm silence. When silenced, the alarm lamp will remain on until the alarm condition is corrected. If the alarm condition is not corrected within 15 minutes, the audible alarm will be reactivated.

POWER FAILURE ALARM (MODELS C100 AND C200). If primary power to the Incubator is interrupted for any reason, including a disconnected power cord, an audible alarm is activated and an alarm lamp lights. This alarm can be deactivated only by restoring the primary power or setting the Incubator POWER Switch off.

3.2.5 FUNCTIONAL DESCRIPTION C100/200–2 QT® VERSION (SERIES –02) INCUBATORS

VERTICAL HEIGHT ADJUSTABLE STAND (OPTION)

The Vertical Height Adjustable Stand (VHA) provides the Isolette Incubators, Models C100/200–2, QT® Version Incubators with the capability of varying mattress height over a range of 8 inches. The VHA Stand is powered by an electric motor which is controlled by a momentary Up/Down Switch. The VHA Stand has its own power cord and provides power to the Incubator which is mounted on it. In addition, if the the VHA Stand circuit breaker opens, power will still be provided to the Incubator which is protected by its own circuit breaker.

CONTINUOUSLY VARIABLE MATTRESS TILT MECHANISM

The C100/200–2 QT® Version Incubators are equipped with 0 to 9 degree continuously variable mattress Tilt Mechanisms which permit placing the infant in the Trendelenburg or reverse Trendelenburg positions.

QUIET LATCH ACCESS DOORS

The C100/200–2 QT® Version Incubators are equipped with four quiet latching Access Doors. The latch mechanism of these doors is designed such that the doors may be opened with an elbow one at a time or simultaneously.

SWIVEL SHELVES, CABINETS AND DRAWERS (ACCESSORIES)

The C100/200–2 QT® Version Standard Cabinet Stand may be equipped with up to four post–mounted swivel shelves. The VHA Stand maybe equipped with one or two Cabinet or Drawer Modules or one of each. These Modules may also be equipped with fold down Side Shelves. The Cabinet is also available with a metal door, a see–through door or no door at all.

3.3 DETAILED CIRCUIT DESCRIPTION

3.3.1 GENERAL

This paragraph provides detailed circuit descriptions of the Controllers. An overall functional description is provided elsewhere in this section.

All electronics, except the temperature probes, air circulation fan, heater connectors, etc., is contained on two printed circuit boards. A detailed functional description of these printed circuit boards and their relationship with the probes, air circulation fan, heater, connectors, etc., are provided in the following paragraphs.

3.3.2 CONTROLLER TEMPERATURE CONTROL AND ALARM LOGIC (PCB2)

PCB2 consists of an analog section and digital section. The analog section (Figure 3.2) monitors the probes, sensors, and set temp switches; it also contains the power supply, temperature control, heater control, and power failure alarm circuitry.

The digital section contains the master clock, auto test, 15 minute silence, and one hour inhibit circuitry. In addition, it contains the 9 to 18 second delay circuitry and alarm latches.

AIR DATA CIRCUITRY (Figs. 3.3 and 7.1 or 7.2) The function of the Air Data Circuitry is to monitor either the Air Temperature Probe RT1–A or the Auxiliary Probe and Air Set Temp Switches and provide an error signal to the Temperature Control circuitry.

The Air Temperature thermistor RT1–A is connected across a linearization network consisting of R34, R36, R37, and R38. When the Auxiliary Probe is connected to jack J20, RT1–A is disconnected from the network and the Auxiliary Probe is connected to the network. The output of the linearization network is applied to differential amplifier AR4–1. This amplifier has a gain of 15 and has an output of 200 mV/°C. The output of AR4–1 is applied to the Air Limit Circuitry and the junction of R44 and R45, the air temperature summing point. The other input to this summing point is from AR4–2, the set temp amplifier. AR4–2 is connected to the Air Temperature set temp switches and is a current–to–voltage amplifier whose output is –500 mV/°C and is also applied to the junction of R44 and R45. The summed voltage, which represents the difference between the Incubator air temperature and set temp temperature, is applied to AR6–1, an error amplifier whose output is

5.0 volts per +/– 1.5 °C difference between the Incubator air temperature and set temp temperature. The output of AR6–1 is applied to the Temperature Control circuitry via S1–B* and the TEMP Fail Circuitry via R77.

***SKIN DATA CIRCUITRY** (Figs. 3.2 and 7.1). The function of the Skin Data Circuitry is to monitor the Skin Probe RT2 and Skin Set Temp switches and provide an error signal to the Temperature Control circuitry. The Skin Temperature Probe is connected across a linearization network consisting of R50 through R53. The output of the linearization network is applied to differential amplifier AR5–1. This amplifier has a gain of 15 and has an output of 200 mV/°C. The output of AR5–1 is applied to the Probe Fail Circuitry via S1–D. In addition, the output is applied to the junction of R47 and R55, the skin temperature summing point. The other input to this summing point is from AR5–2, the set temp amplifier. AR5–2 is connected to the Skin Temperature set temp switches, and is a current–to–voltage amplifier whose output is 500 mV/C. The summed voltage which represents the difference between the infant's skin temperature and the set temp switches is applied to AR6–4, an error amplifier, whose output is 5.0 volts per +/– 1.0 °C difference between skin temperature and set temp temperature. The output of AR6–4 is applied to the Temperature Control Circuitry via S1–B and the Temp Fail Circuitry via S1–C.

PROBE FAIL ALARM CIRCUITRY. The Probe Fail Alarm Circuitry is split between the analog and digital portions of PCB2. The following discussion is divided accordingly.

ANALOG (Figs. 3.2, and 7.1 or 7.2). The output of the Air Data (AR4–1) or Skin Data (AR5–1)* circuitry is applied to the Probe Fail circuitry across CONTROL MODE Switch S1–D*. When a temperature sensing thermistor shorts, the output of the differential amplifier (AR4–1 air, AR5–1 skin)* goes to approximately +10 volts (saturation) which causes AR9–1 pin 13 to go low and activate the probe failure alarm circuitry.

When a temperature sensor thermistor opens, the output of the differential amplifier (AR4–1 air, AR5–1 skin*) goes to –6.5 volts and causes AR9–2 pin 14 to go low and activate the probe failure alarm circuitry. If the Air Flow probe RT4 opens, the output of AR7–2 pin 7 will go to approximately –8 volts. The –8 volts will cause AR3–2 pin 14 to go low and activate the Probe Fail Alarm circuitry.

* Model C100 only.

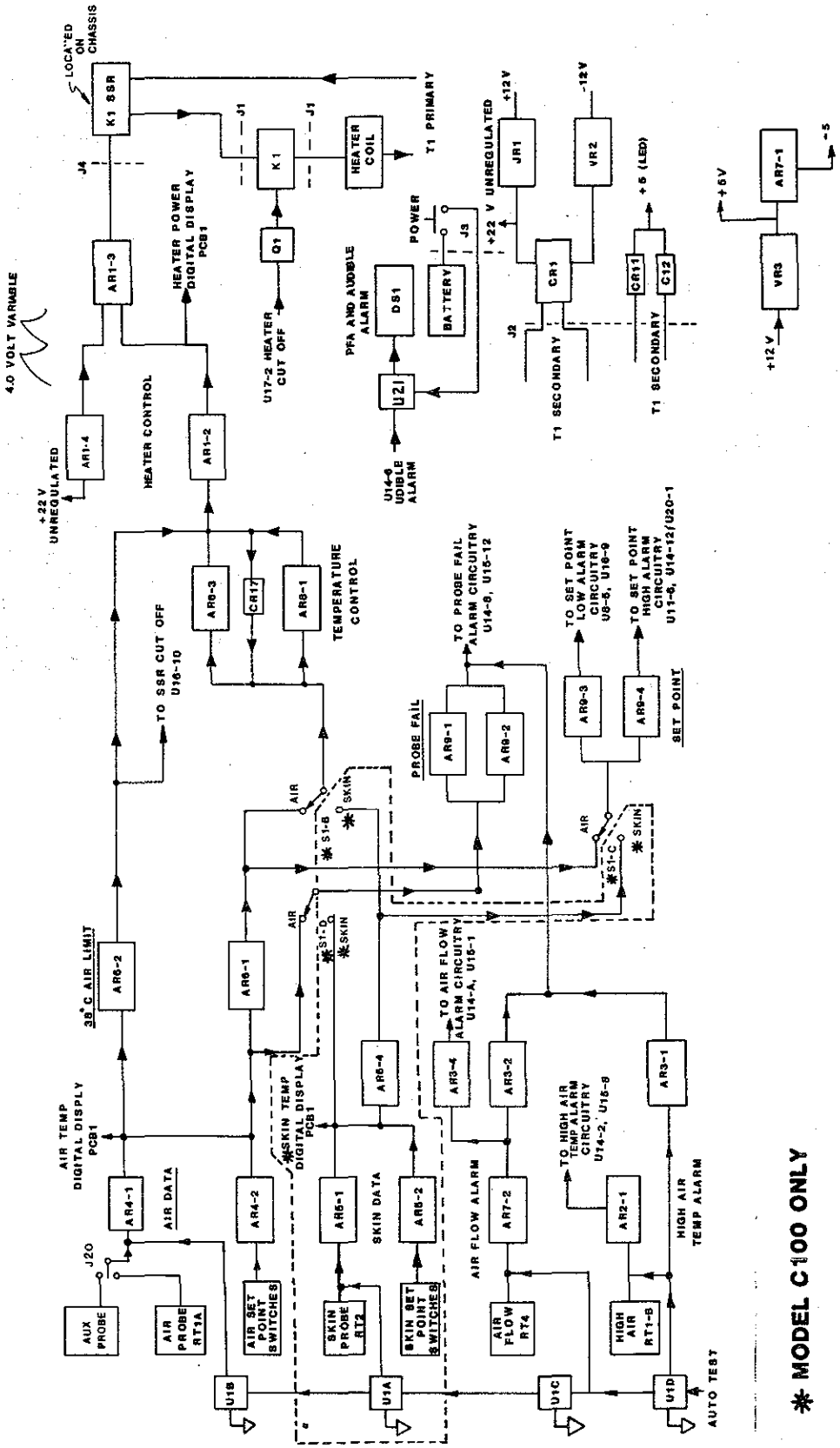


FIGURE 3.2 FUNCTIONAL BLOCK DIAGRAM, PCB2 ANALOG SECTION.

IMPORTANT: The probe alarm will be actuated within 9 to 18 seconds if the air flow sensor is open–circuited and the temperature sensed below the mattress deck is greater than approximately 30 °C; however, if the temperature sensed below the mattress deck is less than approximately 30 °C, the alarm will not be actuated. During warm–up, it can take anywhere from 15–30 minutes before the alarm is actuated, depending on the temperature set point and ambient room temperature. The "probe alarm" indicating an open–circuited air flow sensor will not occur if the set point temperature is below 29 °C.

DIGITAL (Figs. 3.3, 7.1 or 7.2). When a Probe Failure occurs, a logic low is applied to U14–A (pin 8). This low causes U16–B (pin 4) to go low and start the 9 to 18 second Delay Timer U5–A and U5–B. After the timer times out, U5–B (pin 13) goes low and is applied to U15–D (pin 13), U15–C (pin 9), and U15–A (pin 2).

The low at U14–A (pin 8) is also applied to U15–3 (pin 12) thus determining that the alarm is a Probe Failure Alarm. U15–D (pin 11) goes high and will set latch U19–B (pin 1) high at the next clock pulse. The high at U19–B (pin 1) is applied to U18–A (pin 1) whose other input is the flashing signal from the Alarm Flash Circuitry U16–A (pin 2). The output of U18–A (pin 3) then flashes the PROBE lamp on the front panel.

The output of U19–B (pin 1) is also applied to U20–C (pin 11) which will pulse the audible alarm on and off via U11–A and U14–B. If the Probe Failure is related to either the air or skin* thermistor, the alarm will sound continuously because the set temp high alarm has also been activated and the clock signal at U14–C (pin 11) is blocked out by the low at U14–C (pin 12). In addition to sounding the alarm, the high at U19–B (pin 1) turns off the SSR via U16–F, U20B, and U16–E (pin 10). The output of U16–E (pin 10) is also connected to U17–B (pin 5). U17–B will disconnect the Heater Coil via Q1 and K1 after one Master Clock pulse.

This alarm is not resettable because of the nature of the alarm (the defective probe must be replaced). However, if a set temp high alarm occurred indicating that the probe failure is related to either skin* or air, the SET TEMP lamp will stop flashing and stay on continuously after reset.

NOTE: MODELS C68–2 AND C82–1 SERIES 01. Insertion of Remote Alarm Plug will disable the internal Audible Alarm with the exception of the Power Failure Alarm.

TEMP FAIL (SETPOINT) ALARM CIRCUITRY. The Temp Fail (Set temp) Alarm Circuitry is split between the analog and digital portions of PCB2. The following discussion is divided accordingly.

ANALOG (Figs. 3.2, 7.1 or 7.2). The output of the Air Data or Skin Data* circuitry is applied to the Temp. Fail (Set Temp) circuitry. In the Air Mode, when the air temperature falls 3.0 °C below set temp, the output of Error Amplifier AR6–1 will go to +8.8 volts. This +8.8 volts applied to AR9–3 (pin 4) causes AR9–3 (pin 2) to go low

* Model C100 only.

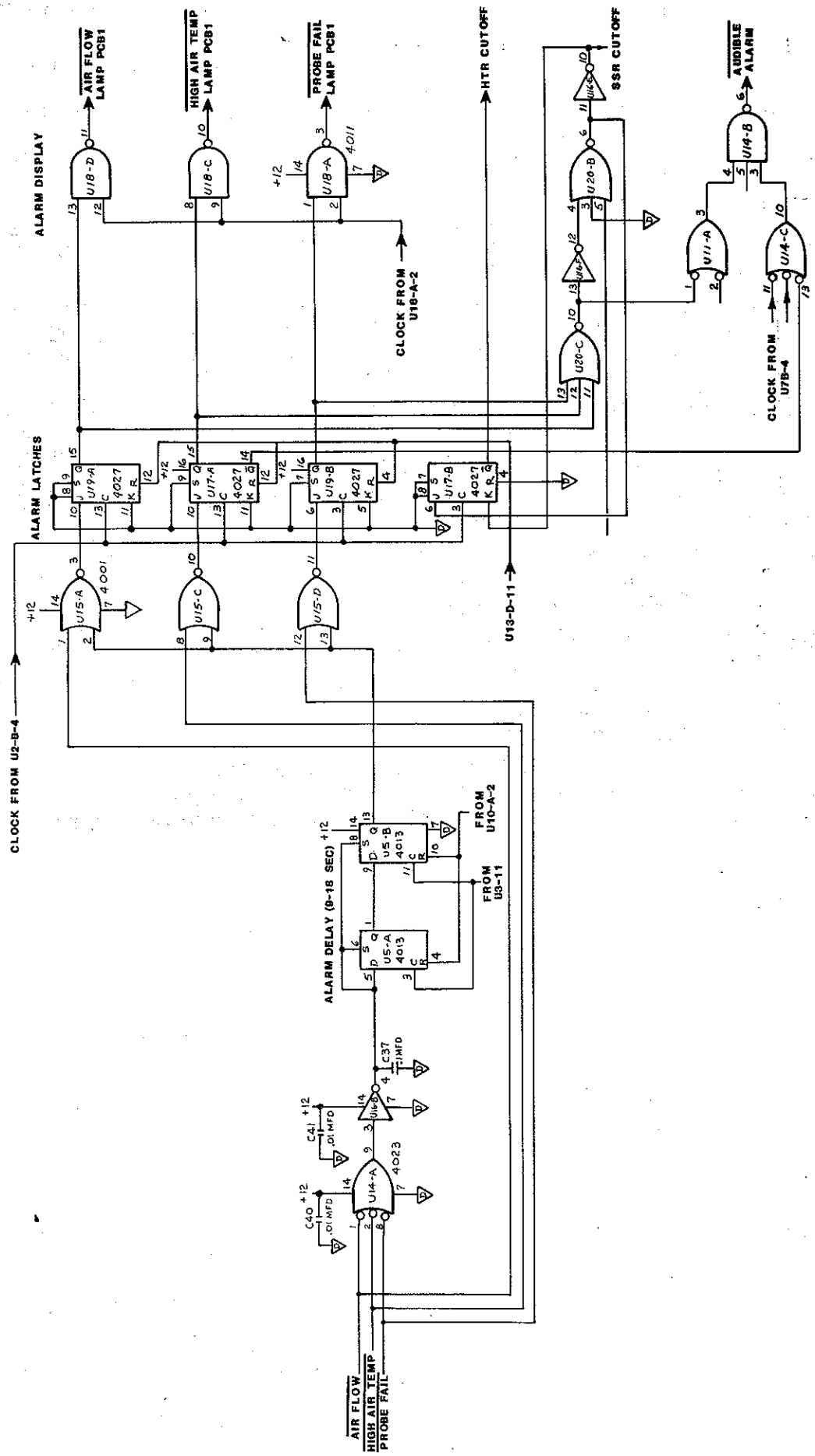


FIGURE 3.3 FUNCTIONAL BLOCK DIAGRAM, AIR FLOW, HIGH AIR TEMP, AND PROBE FAILURE ALARM CIRCUITRY (SIDEWAYS)

and activate the Set Temp Low Alarm circuitry. When the air temperature rises 1.5 °C above set temp, the output of AR6–1 goes to –5.0 volts. This –5.0 volts is applied to AR9–4 (pin 7) and causes AR9–4 (pin 1) to go low and activate the Set Temp High Alarm circuitry

*In the Skin Mode when the skin temperature rises above or falls below 1°C of set temp, the output of Error Amplifier AR6–4 will go to either plus or minus 5 volts. This voltage is applied through S1–C (pin 6) to AR9–3 and AR9–4, which control the Low and High SET TEMP alarm circuits, respectively. When the voltage is +5 volts, the SET TEMP Low Alarm is activated; when the voltage is –5 volts the SET TEMP High alarm is activated.

DIGITAL – SET TEMP HIGH ALARM (Figs. 3.4, 7.1 or 7.2). When a Set Temp High Alarm occurs a logic low is applied to U11–B (pin 6), U14–C (pin 12), and U20–A (pin 1). The low at U11–B (pin 6) activates the (9–18 SEC) Set Temp Alarm Delay (U12–A and U12–B) and places U15–B (pin 5) low. After the delay circuitry times out, U12–B (pin 13) goes low and places U15–B (pin 6) low which activates U18–B (pin 4) and flashes the SET TEMP lamp on the front panel (Note the clock pulses on U18–B (pin 6) from U13–B (pin 4)).

The low at U14–C (pin 12) activates the Audible Alarm continuously after an 8 to 9 second delay. The audible alarm delay is controlled by the output of U9–C and U11–A.

The low at U20–A (pin 1) cuts off the Solid State Relay K1 via U20–B and U16–E. This occurs 9 to 18 seconds after the alarm because of the input at U20–A pin 8 from the delay circuitry. The output of U16–E (pin 10) is also applied to U17–B (pin 5), which after one Master Clock pulse, disconnects the Heater Coil via Q1 and K1.

This alarm may be silenced for a period of 15 minutes; refer to the 15 Minute Timer Circuit description.

DIGITAL – SETPOINT LOW ALARM (Figs. 3.5, 7.1 or 7.2). A Set Temp Low Alarm occurs when the skin* or air temperature is below the setting of the set temp switches. This alarm is disabled for one hour after turn on.

When a set temp low alarm occurs a logic low is applied to U8–A (pin 5) and U16–D (pin 9). The low at U16–D (pin 9) is inverted and applied to U11–D (pin 13). U11–D (pin 11) will go low if U11–D (pin 12) is at a logic high. U11–D (pin 12) can only be high one hour after turn on or 2.5 minutes after set temp is reached; refer to the One Hour Timer circuit description.

* Model C100 only.

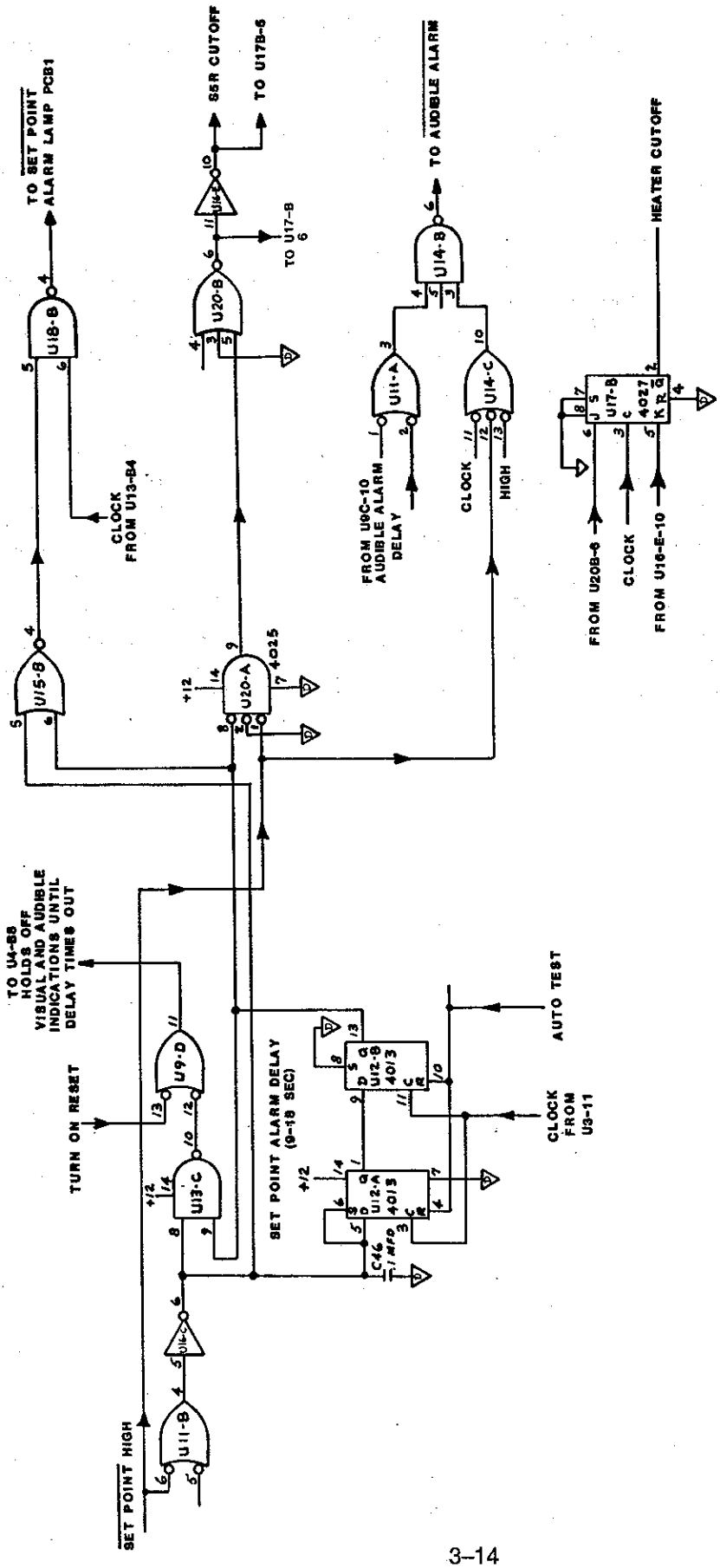


FIGURE 3.4 FUNCTIONAL BLOCK DIAGRAM, SET TEMP HIGH ALARM CIRCUITRY

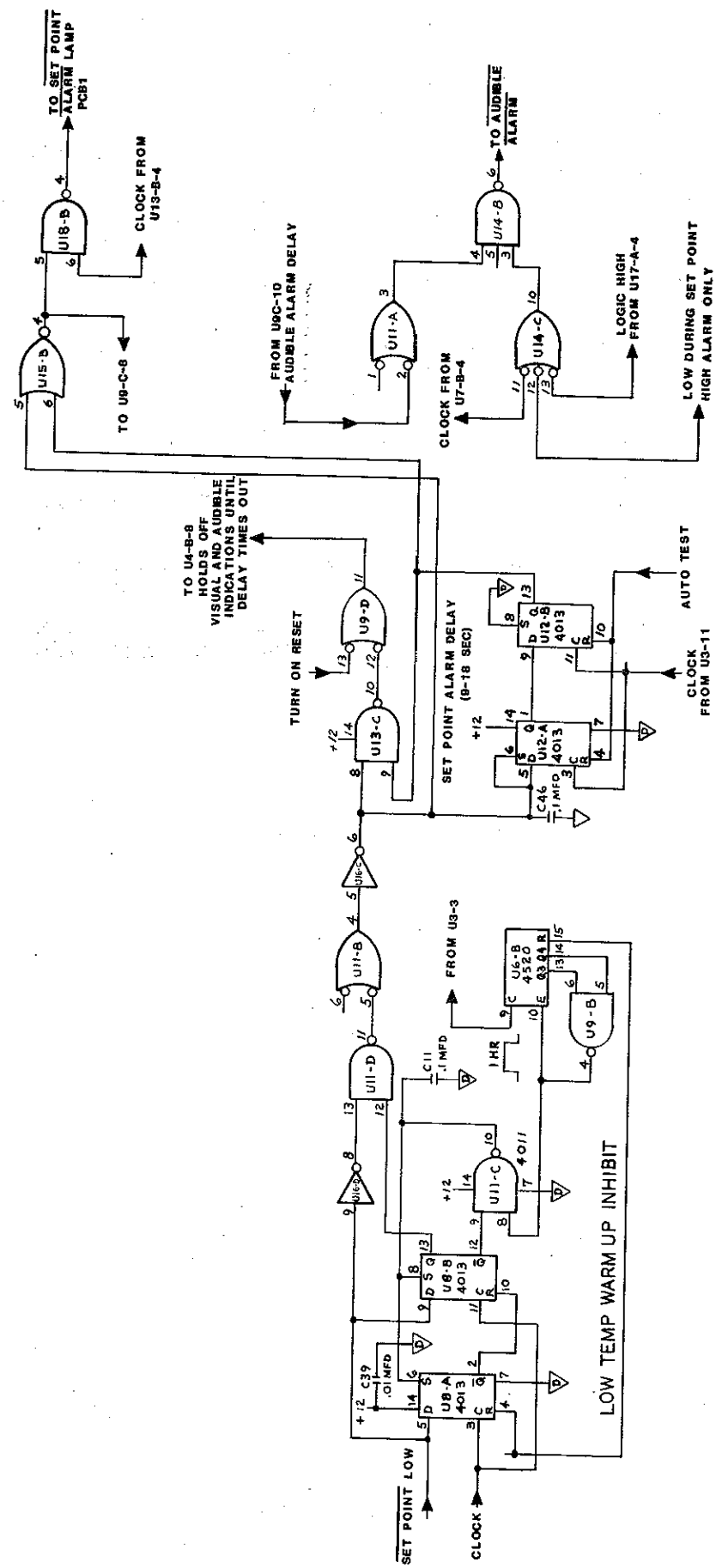

TO SET POINT ALARM LAMP PCB1
CLOCK FROM U13-B-4
TO U9-C-8
FROM U9C-10 AUDIBLE ALARM DELAY
CLOCK FROM U7-B-4
TO AUDIBLE ALARM
LOGIC HIGH FROM U17-A-4
LOW DURING SET POINT HIGH ALARM ONLY
TO U4-B-8 HOLDS OFF VISUAL AND AUDIBLE INDICATIONS UNTIL DELAY TIMES OUT
TURN ON RESET
SET POINT ALARM DELAY (8-18 SEC)
AUTO TEST
CLOCK FROM U3-11
FROM U3-3
LOW TEMP WARM UP INHIBIT
SET POINT LOW
CLOCK

FIGURE 3.5 FUNCTIONAL BLOCK DIAGRAM, SET TEMP LOW ALARM CIRCUITRY

When U11–D (pin 11) goes low, the 9–to–18 second delay timer is activated by U11–B (pin 4) and U16–C (pin 6). After the delay circuit times out, U12–B (pin 13) goes low and places U15–B (pin 6) low which activates U18–B (pin 4) and flashes the SET TEMP light (note the clock pulses on U18–B (pin 6) from U13–B (pin 4).

The audible alarm will be pulsed on and off because of the following conditions. U14–C (pins 12 and 13) are at a logic high which permits the clock at pin 11 to be gated through to U14–B (pin 3). U14–B (pin 5) is at a logic high after the auto sequence (refer to Auto Test Circuit description). U14–B (pin 4) is at a logic high because there are no other alarms and the SILENCE/RESET button has not been depressed. This alarm may be silenced for a period of 15 minutes, refer to the 15 Minute Timer Circuit description.

AIR FLOW ALARM CIRCUITRY. The Air Flow Alarm Circuitry is split between analog and digital portions of PCB2. The following discussion is divided accordingly.

ANALOG (Figs. 3.2, 7.1 or 7.2) Thermistor RT4, which is located between the Heater and Fan, is heated by the current flow from +12 volts via R31 to ground. This current flow maintains the voltage at the junction of R31 and R40 at approximately +11.0 volts. In the event that the fan stops turning or RT4 is short–circuited, the voltage at the junction of R31/R40 will go to approximately +6 volts due to the rise in temperature. The +6 volts at the input of AR7–2 will cause its output to rise to +5.5 volts and cause the output of comparator AR3–4 (pin 13) to go low and activate the Air Flow Alarm circuitry. If RT4 shorts, the output of AR7–2 will rise to approximately 11.0 volts and cause the output of comparator AR3–4 (pin 13) to go low and activate the Air Flow Alarm circuitry.

DIGITAL (Figs. 3.3, 7.1 or 7.2) . An Air Flow Alarm occurs when the Air Circulation across the heater coil stops or the Air Flow Probe RT4 is short–circuited.

When an Air Flow Alarm occurs, a logic low is applied to U14–A (pin 1). This low causes U16–B (pin 4) to go low and start the 9– to 18– second Delay Timer U5–A and U5–B. After the timer times out, U5–B (pin 13) goes low and is applied to U15–D (pin 13), U15–C (pin 9), and U15–A (pin 2).

The low at U14–A (pin 1) is also applied to U15–A pin 1, thus determining that the alarm is an Air Flow Alarm. U15–A (pin 3) goes high and will set latch U19–A (pin 15) high at the next clock pulse.

The high at U19–A (pin 15) is applied to 18–D (pin 13) whose other input is the flashing signal from the Alarm Flash Circuitry U16–A (pin 2). The output of U18–D (pin 11) then flashes the AIR FLOW lamp on the front panel.

The output of U19–A (pin 15) is also applied to U20–C (pin 11) which sounds the pulsating audible alarm via U11–A and U14–B. In addition, it turns off the SSR via U16–F, U20–B, and U16–E (pin 10). The output of U16–E (pin 10) is also connected to U17–B (pin 5). U17–B will disconnect the Heater Coil via Q1 and K1 after one Master Clock pulse.

When the SILENCE/RESET button is depressed, latch U19–A will be reset via U13–D. However, if the alarm condition still exists, the latch will be set again at the next Master Clock pulse.

HIGH AIR TEMPERATURE ALARM CIRCUITRY. The High Air Temperature Alarm Circuitry is split between the analog and digital portion of PCB2. The following discussion is divided accordingly.

ANALOG (Figs. 3.2, 7.1 or 7.2). The High Air Temperature Circuitry is controlled by thermistor RT1–B. As long as the Air Temperature is between 20 and 39.5C, the voltage at input of AR2–1 (pin 5/6) will be greater than 2.6 volts. When the air temperature rises above 39.5C the input voltage falls below 2.6 volts and the output of AR2–1 (pin 7) will go low and activate the High Air Temperature Alarm Circuitry. In the event that the thermistor shorts the output of AR2–1 (pin 7) will also go low and activate the High Air Temperature Alarm circuitry.

If RT1–B opens the output of AR3–1 (pin 2) will go low and activate the Probe Failure Alarm Circuitry.

DIGITAL (Figs. 3.3, 7.1 or 7.2) When a High Air Temperature Alarm occurs, a logic low is applied to U14–A (pin 2). This low causes U16–B (pin 4) to go low and start the 9– to 18– second Delay Timer U5–A and U5–B. After the timer times out, U5–B (pin 13) goes low and is applied to U15–D (pin 13), U15–C (pin 9), and U15–A (pin 2).

The low at U14–A (pin 2) is also applied to U15–C (pin 8) thus determining that the alarm is a High Air Temperature Alarm. U15–C (pin 10) goes high and will set latch U17–A (pin 15) high at the next clock pulse.

The high at U17–A (pin 15) is applied to U18–C (pin 8) whose other input is the flashing signal from the Alarm Flash Circuitry U16–A (pin 2). The output of U18–C (pin 10) then flashes the HIGH TEMP lamp on the front panel.

The output of U17–A (pin 15) is also applied to U20–C (pin 11) which sounds the audible alarm continuously via U11–A and U14–B. The alarm will sound continuously and not pulsate because U17–A (pin 14) is low and is connected to U14–C (pin 13). This low blocks out the flashing signal at U14–C (pin 11). In addition to sounding the alarm, the high at U17–A (pin 15) turns off the SSR via U16–F, U20–B, and U16–E (pin 10). The output of U16–E (pin 10) is also connected to U17–B (pin 5). U17–B will disconnect the Heater Coil via Q1 and K1 after one Master Clock pulse.

When the SILENCE/RESET button is depressed, latch U17–A will be reset via U13–D. However, if the alarm condition still exists, the latch will be set again at the next Master Clock pulse.

38 °C AIR LIMIT CIRCUITRY** (Figs. 3.2, 7.1 or 7.2). The function of the 38.5 °C** Air Limit Circuit is to shut down the heater when the Incubator air temperature exceeds 38 °C**. When the output of AR4–1 (pin 1) goes above 3.6 volts (38 °C) (see Note Below) the output of AR6–2 (pin 14) goes high and shuts down the Temperature Control Circuitry which in turn will shut down the Heater Control Circuitry.

TEMPERATURE CONTROL CIRCUITRY (Figs. 3.2, 7.1 or 7.2) Upon initial turn on, the air temperature of the Incubator or the infants skin temperature will be low and the error voltage at TP20 (air) or TP13 (skin*) will be highly positive. This positive voltage saturates AR6–3 negative. This negative saturation forward biases CR17 and cancels out the positive voltage at the junction of CR21 and R79 and drives it to approximately –6.0 volts.

This –6 volts bias drives the output of AR8–1 to ground potential in approximately 1/2 second because of the time constant developed by R67 and C25. This in effect cancels AR8–1 out of the circuit and permits the Heater Control Circuitry to apply full power to the Heater.

* Model C100 only.

** 38.5 °C in current production Incubators and in Incubators that have been retrofitted for Air Temperature limit of 38.5 °C. See Tables 6.9 and 6.11 for details.

NOTE: 3.7 volts (38.5 °C) in current production Incubators and Incubators that have been retrofitted for Air Temperature Limit of 38.5 °C.

As the temperature approaches control point, the voltage at TP20 becomes less positive, this in turn causes the output of AR6–3 to become less negative. At approximately 0.9 °C below set temp AR6–3 comes out of negative saturation and goes toward 0 volts. This in turn causes the voltage at the junction of R79 and CR21 to rise toward 0 volts and then go positive as the temperature in the Incubator reaches set temp.

This positive voltage turns CR21 off and causes the output of AR8–1 to go negative at a time constant of 1 minute created by C26 and R68. This negative voltage is applied to the summing point of R70 and R72 and will cancel any overshoot as the temperature reaches set temp. In addition, if the door is opened, the temperature will drop and TP20 will go positive and drive AR8–1 into saturation and permit the Heater to go on full. After the door is closed, the temperature will rise and AR8–1 will function as previously described to cancel any overshoot as the temperature reaches set temp.

The voltage at the summing point of R70 and R72 is applied to AR1–2. The output of AR1–2 is limited to +4.0 volts at full power by the Temperature Control circuitry and varies between +1 and +2 volts (1/4 to 1/2 power) at set temp.

HEATER CONTROL CIRCUITRY (Figs. 3.2, 7.1 or 7.2) AR1–4 and its associated circuitry provide a variable triangular waveform as illustrated in Figure 3.6.

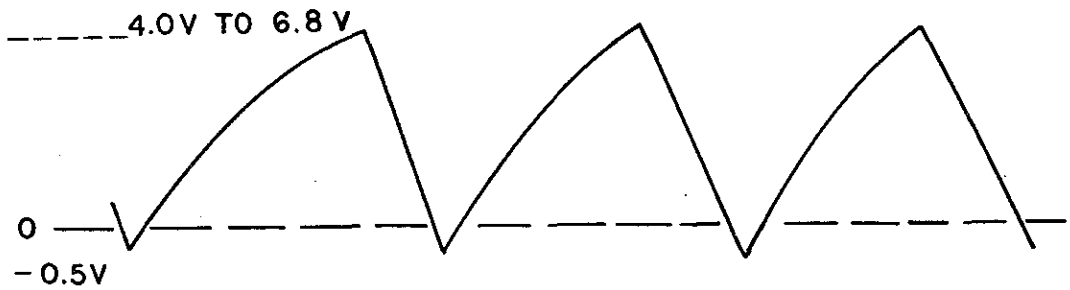


FIGURE 3.6 VARIABLE TRIANGULAR WAVEFORM

The amplitude of the waveform is directly affected by the +22V unregulated voltage which supplies voltage divider network R96, R97, and R100. Since the +22 volt unregulated supply will drift up and down with the ac line voltage, the amplitude of the waveform will also increase and decrease with increases and decreases of ac line voltage. This varying triangular waveform is one input to AR1–3 which controls Heater Relay K1 and SSR (Solid State Relay). The other input to AR1–3 is the output of the Temperature Control Circuitry.

As illustrated in Figure 3.7 when full power is required and the line voltage is 95 Vac the output of AR1–3 (TP–15) will be –12 volts constantly, because the output of the temperature control circuitry is +4.0 volts and the amplitude of the triangular waveform will never rise above 4.0 volts.

When full power is required at a line voltage of 135 Vac the output of AR1–3 will be off (positive) for 54% of the time which is the amount of time the triangular waveform is above the 4.0 volt bias level supplied by the temperature control circuitry.

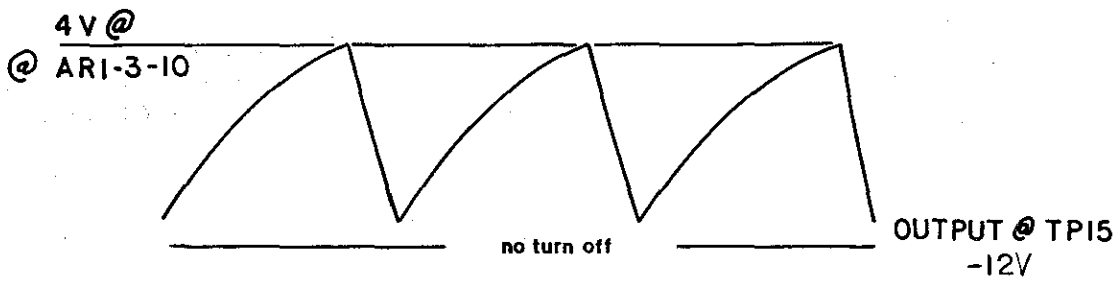
Similarly at a line voltage of 120 Vac the output of AR1–3 will be off (positive) for 36% of the amount of time which the triangular waveform is above the 4.0 volt bias level supplied by the Temperature Control Circuitry.

When the temperature of the Incubator reaches set temp, the output of AR1–3 will be off (positive) for 75% of the amount of time which the triangular waveform is above the +1.0 to 2.0 volts bias level supplied by the Temperature Control Circuitry.

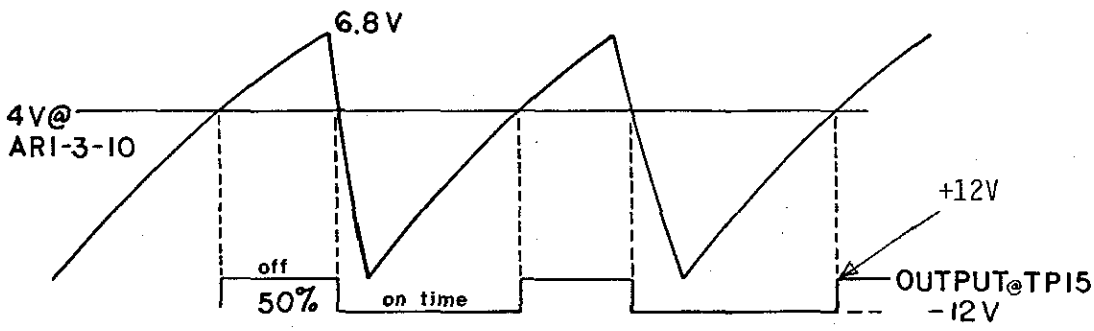
HEATER COIL CIRCUITRY (Figs. 3.2, 7.1 or 7.2). The Heater Coil HTR1 is connected across the ac line and is turned on and off by Heater Power relay K1 which is a solid state relay controlled by the Heater Control circuitry described above.

POWER FAILURE ALARM (PFA) AND AUDIBLE ALARM CIRCUITRY (Figs. 3.2, 7.1 or 7.2). The Power Failure Alarm (PFA) and Audible Alarm circuitry consists of Q2, U21, DS1, and ENTRY 1. When the POWER switch (S1–3C–4C) is on and the ac line voltage is absent, the –12 volts which keeps Q2 turned on and U21 and DS1 off, will disappear and the battery will activate DS1 and turn on the POWER FAIL indicator on PCB1. During an alarm condition the alarm is activated by a logic low from the digital logic circuitry at TP7.

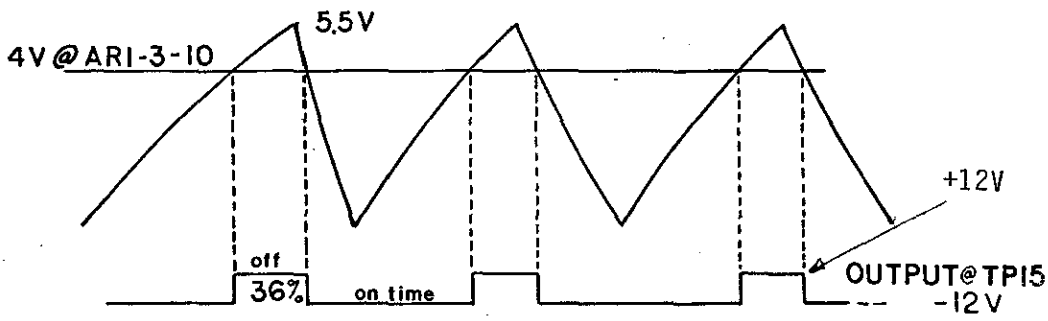
Change 14



A. WITH 95 Vac LINE VOLTAGE



B. WITH 135 Vac LINE VOLTAGE



C. WITH 120 Vac LINE VOLTAGE

FIGURE 3.7 HEATER POWER CONTROL AT FULL POWER

HEATER CUT OFF CIRCUITRY (Figs. 3.2, 7.1 or 7.2). Transistor Q1 will disconnect the Heater from the ac line via relay K1 during all alarm conditions except SET TEMP low. The alarm circuitry is discussed in detail elsewhere in this section.

POWER SUPPLY (Figs. 3.2, 7.1 or 7.2). The power supply accepts a voltage from the secondary of T1 and puts out 12 volts regulated dc via VR1 and VR2. The +12 Vdc is also regulated at +5 Vdc by VR3. The output of VR3 is also applied to inverter AR7–1 which supplies a –5.0 Vdc which tracks the +5.0 Vdc.

The power supply also provides an unregulated +5.0 Vdc for the LED's and unregulated –22 Vdc for the Heater Control Circuitry.

POWER UP RESET (Figs. 3.8, 7.1 or 7.2). The Power Up Reset circuitry consists of U7–C, U7–D, U9–A and RC network R114 and C35. Upon turn on, C35 is discharged and the outputs of gates U7–C, U7–D, and U9–A are high until C35 charges up and then they go low. This logic low resets the counters and starts the Master Clock.

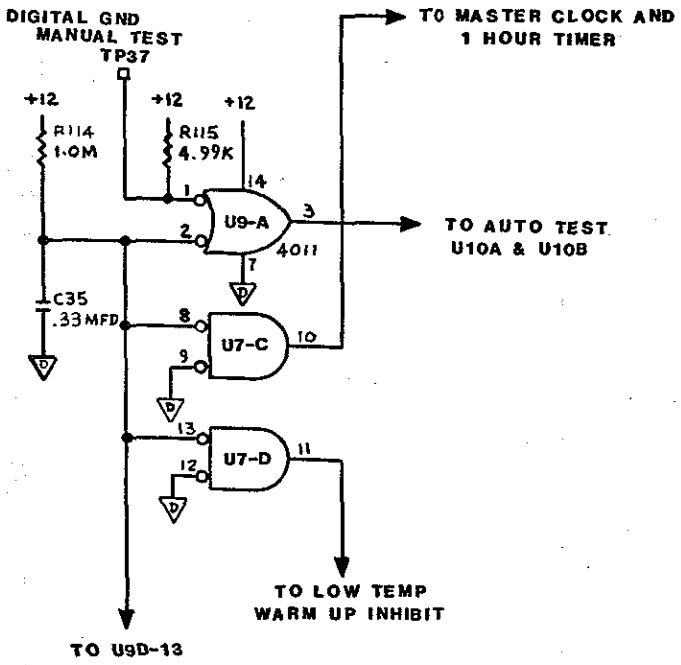


FIGURE 3.8 FUNCTIONAL BLOCK DIAGRAM, POWER UP RESET

MASTER CLOCK (Figs. 3.9, 7.1 and 7.2). The Master Clock consists of U2–C and U2–D. It is an RC ring oscillator which provides a 0.833 Hz square wave.

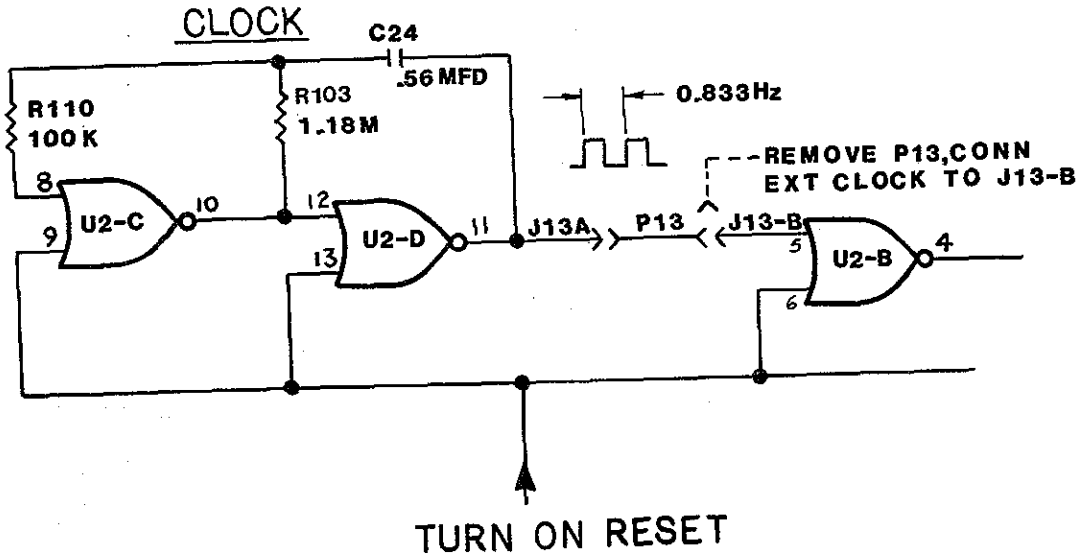


FIGURE 3.9 FUNCTIONAL BLOCK DIAGRAM, MASTER CLOCK

ONE HOUR TIMER (Figs. 3.10, 7.1 and 7.2). The function of the One Hour Timer is to disable the Low Temperature Set Temp alarm for a period of one hour after turn on to permit the Incubator to warm up.

The 1.2 second Master Clock is buffered by U2–B and U2–A and is applied to the clock input of U4–A a dual "D" flip flop which is hooked in a divide by 2 configuration. The output of U4–A is applied to U3 a binary, ripple counter. The Q7 output (pin 3) of U3 then provides a 5.0 minute period clock (2.5 minutes high, 2.5 minutes low) to the clock input of U6–B.

Pins 13 and 14 of U6–B (a synchronous up counter) will go high after twelve 5.12 period clock pulses (1 hour) and disable U6–B via U9–B pin 4. The logic low at U9–B pin 4 is also applied to U11–C pin 8 which disables the Low Temp Warm Up inhibit flip–flops U8–A and U8–B and permits the Set Temp Low Alarm (if present) signal at U16–D (pin 9) to be gated through.

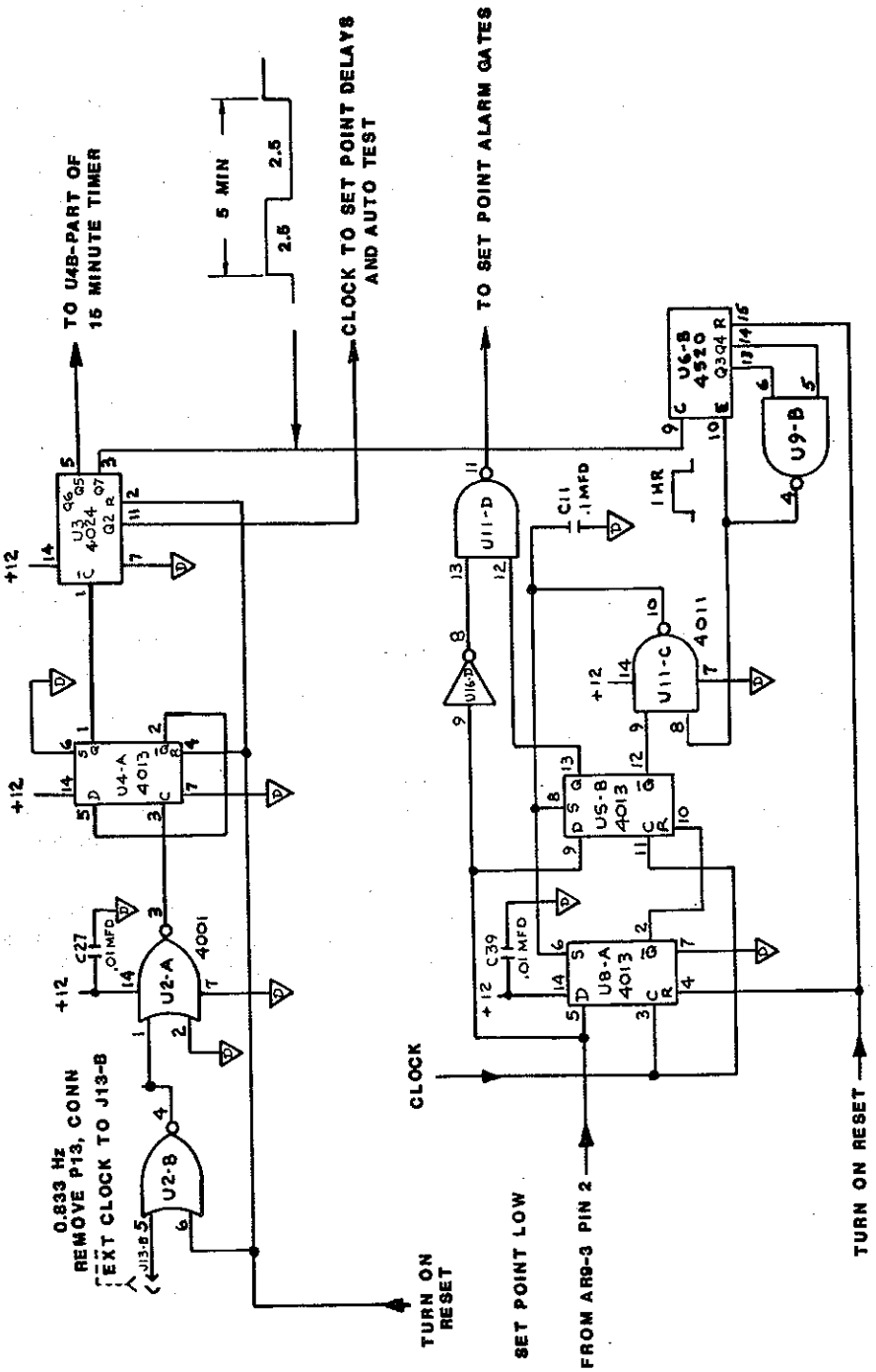


FIGURE 3.10 FUNCTIONAL BLOCK DIAGRAM, ONE HOUR TIMER

If the temperature reaches set temp before one hour, the signal at U8–A (pin 5) goes high. This low to high transition resets the One Hour Timer after a period of 1–1/4 to 2–1/2 minutes (one clock pulse). This delay provides the operator with time to raise the set temp and still keep the One Hour Timer in effect.

15 MINUTE TIMER (Figs. 3.11, 7.1 or 7.2). The purpose of the 15 Minute Timer is to silence the high and low set temp alarms for a period of 15 minutes after the SILENCE/RESET button is depressed.

When the SILENCE/RESET (S2) button is depressed, a logic low is applied to U13–D (pin 13) and U7–A (pin 1). The low at U7–A (pin 1) along with the low at U7–A (pin 2) provides a reset to 15 minute timer U4–B and dual "D" flip–flop U6–A via U7–A (pin 3). Upon reset, U4B (pin 13) will go low and U6–A will begin to count. After a period of 15 minutes, U6–A (pin 6) will go high, and as a result, U4–B (pin 13) will again go high.

The 15 minute low at U4–B (pin 13) is applied to U9–C (pin 9). This low provides a high to U11–A (pin 2), which in conjunction with U11–A (pin 1) blocks the audible alarm. As stated previously, after a period of 15 minutes U4–B (pin 3) goes high and permits the audible alarm to sound.

AUTO TEST (Figs. 3.12, 7.1 or 7.2). Upon turn on, the Auto Test Circuit will activate alarm lamps, and the Digital Display will show all eights for a period of 5 seconds.

When the unit is turned on, U9–A (pin 3) of the reset circuitry resets U10–A and U10–B. Upon reset, U10–A (pin 2) will go high for a period of 5 seconds. This low is applied to PCB1 via J12–20 and causes the Digital Display to show all eights. The logic high at U10–A (pin 2) is also applied to analog switch U1–A, U1–B, U1–C, and U1–D. When these switches turn on, U1–A, U1–B, and U1–D short thermistors RT1–A, RT1–B, and RT2* which creates alarm conditions. Switch U1–C puts AR7–2 (pin 6) to ground via a 10.0K resistor which simulates an Air Flow failure. This logic high also disables the Set Temp Alarm Delay circuitry.

Also, upon reset U10–A (pin 1) goes low, this low is applied to U13–A pin 2 which holds the Alarm Latch resets low via U13–D (pin 11). Since the Alarm Delay timer is disabled, U5–B (pin 13) is low, this permits the alarm inputs at U14–A to be gated through the Alarm Latches and turn on the AIR FLOW, HIGH TEMP, and PROBE alarm lights via U18–A, U18–C, and U18–D.

* Model C100 only.

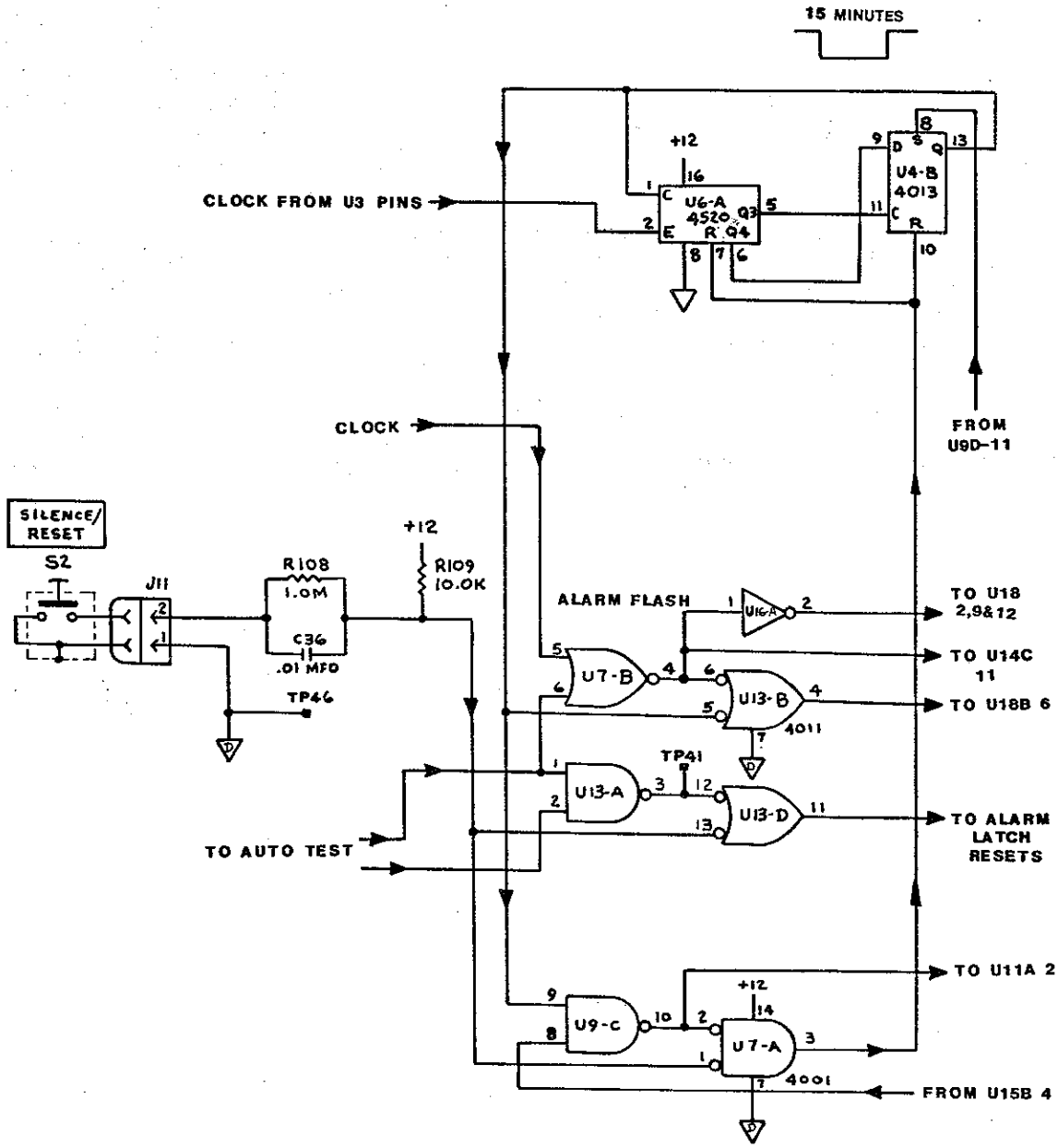


FIGURE 3.11 FUNCTIONAL BLOCK DIAGRAM, 15 MINUTE TIMER

Since the SET TEMP ALARM DELAY timer is also disabled, U12–B (pin 13) is low. This low will turn on the SET TEMP light via U15–B and U18–B. Upon completion of 5 seconds, U10–A and U10–B return to normal and cancel the Auto Test sequence.

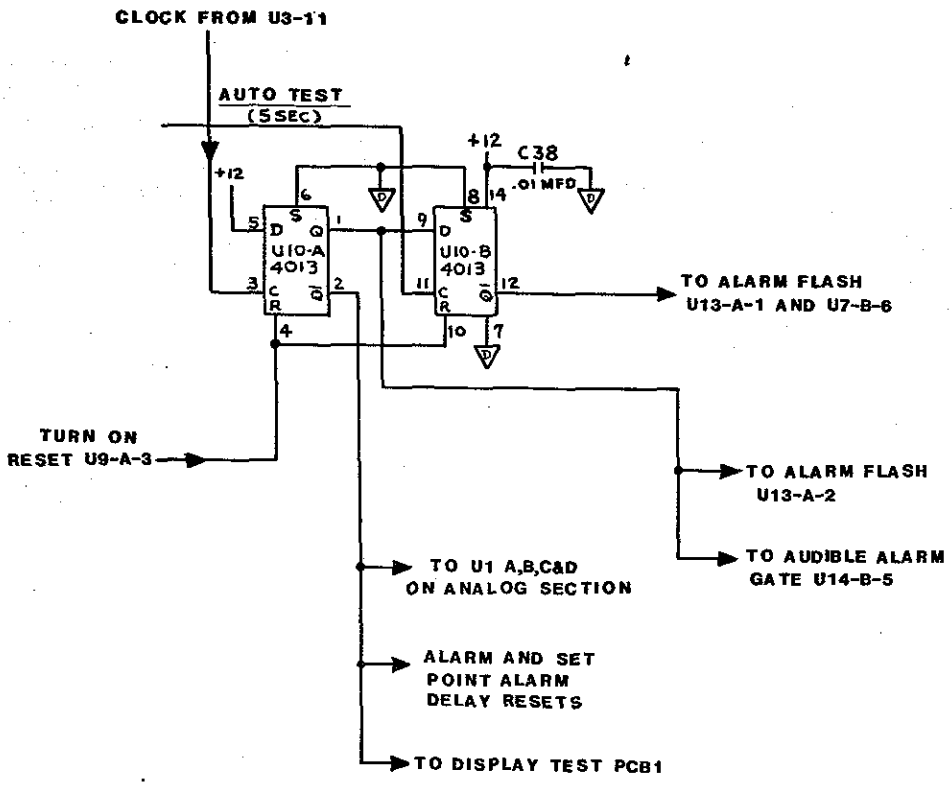


FIGURE 3.12 FUNCTIONAL BLOCK DIAGRAM, AUTO TEST

3.3.3 CONTROLLER DISPLAYS (PCB1)

PCB1 contains the Air and Skin* temperature digital displays, alarm indicators, and Heater Power indicators.

DIGITAL DISPLAYS (Figs. 3.13, 7.1 or 7.2) U1* and U2 are analog to digital converters which provide 3 digit seven segment outputs. During Auto Test a logic high from U10–A (pin 2) on PCB2 is applied to pin 37 of each converter(s) via buffer U3–1 and U3–6. This high puts U1* and U2 in the test mode and the Digital Display(s) will read all eights.

Since the operation of the SKIN* and AIR A/D converters are identical, only operation in the air mode will be described.

The Vin air input at J–18 comes from AR4–1 on PCB2 and is applied to pin 31 of U2. This analog voltage represents current air temperature and U2 converts it to a Digital read–out.

* Model C100 only.

The Display Blank Circuit consists of CR6, CR7, and CR8. When the input signal is removed or the controlling thermistor opens, the junction of CR8 and R20 will go to –6.1 volts. This voltage will saturate the input of U2 (pin 31) and the Digital Display will go blank or flash. This condition will also occur if the controlling thermistor shorts.

The Gain Control (R18) calibrates U2 at 36 °C. The Offset Control R13 calibrates U2 at 20 °C.

ALARM INDICATORS (Figs. 3.13, 7.1 or 7.2) When an alarm condition occurs, a pulsating logic low is applied to the appropriate input of U3–2, –3, –4, or –5 which activates the appropriate alarm lamp. Also, if there is a power failure, the battery voltage is applied to J1–9 (PCB1) which lights the POWER FAIL lamp (DS1 on PCB1) via Q1 (PCB1) to indicate power failure.

HEATER POWER INDICATORS (Figs. 3.13, 7.1 or 7.2) The inverting inputs of AR1–1, AR1–2, AR1–3 and AR1–4 are connected to AR1–2 on PCB2 which is the output of the Temperature Control circuitry. As described previously, the output of this circuit is 1 to 2 volts at set temp and 4.0 volts at full power.

The non–inverting inputs of AR1–1, AR1–2, AR1–3, and AR1–4 are connected to a voltage divider network which provides reference voltages. Depending upon the voltage at the inverting input, the output of the appropriate comparator will go low and light the appropriate Power Indicator.

At 1/4 power, only AR1–1 will be on, at 1/2 power both AR1–1 and AR1–2 will be on, and at full power all the comparators will be on.

***CONTROL MODE INDICATORS** (Figs. 3.13 and 7.1). The Control Mode Indicators SKIN and AIR (DS7 and DS8), are operated by the CONTROL MODE switch S1–A on PCB2 which applies –12 volts.

3.4 CONTROLLER TIMING DIAGRAMS

Timing Diagrams for the Controller are presented in Figure 3.14.

* Model C100 only.

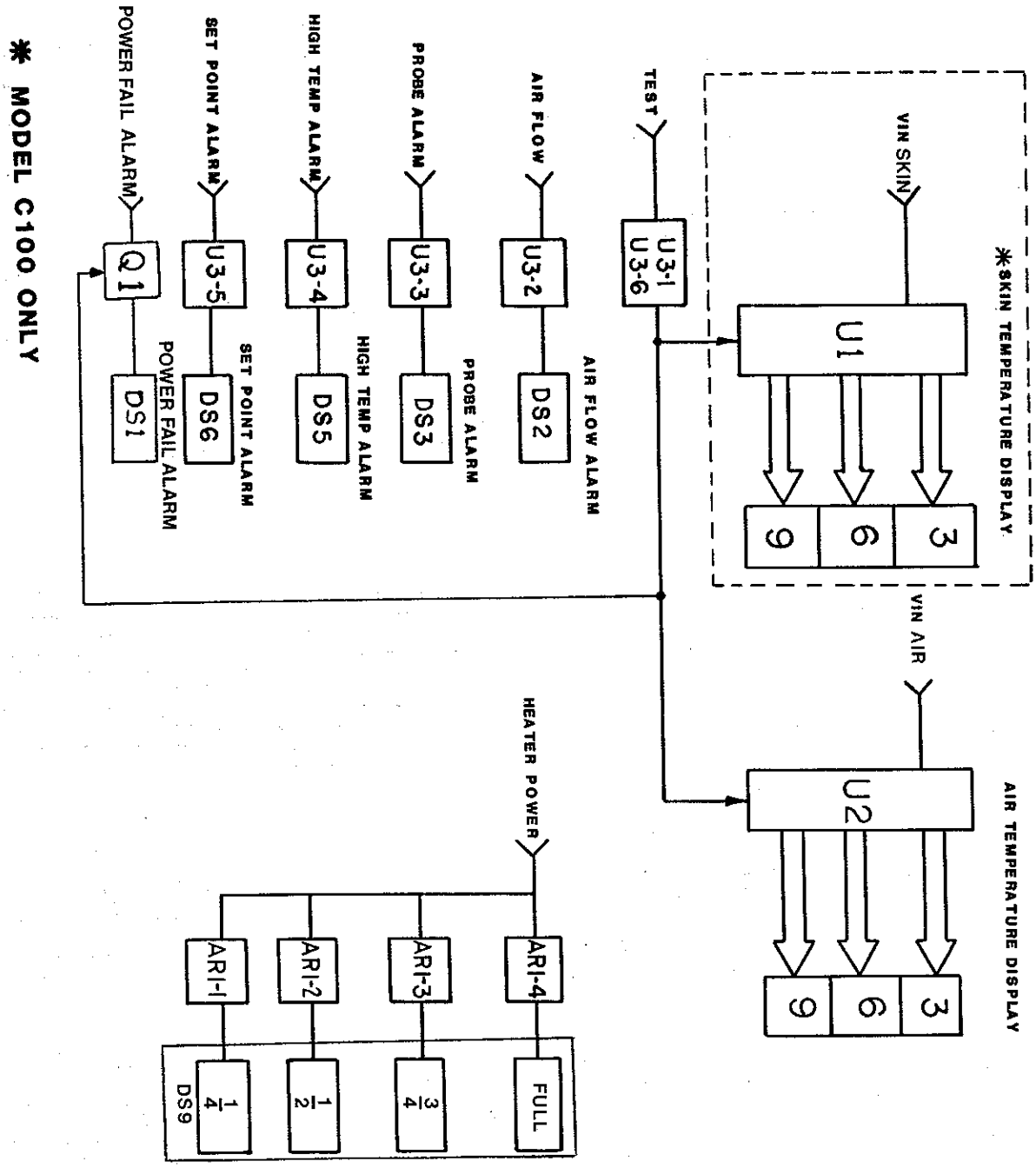


FIGURE 3.13 FUNCTIONAL BLOCK DIAGRAM, PCB1 CONTROLLER DISPLAYS

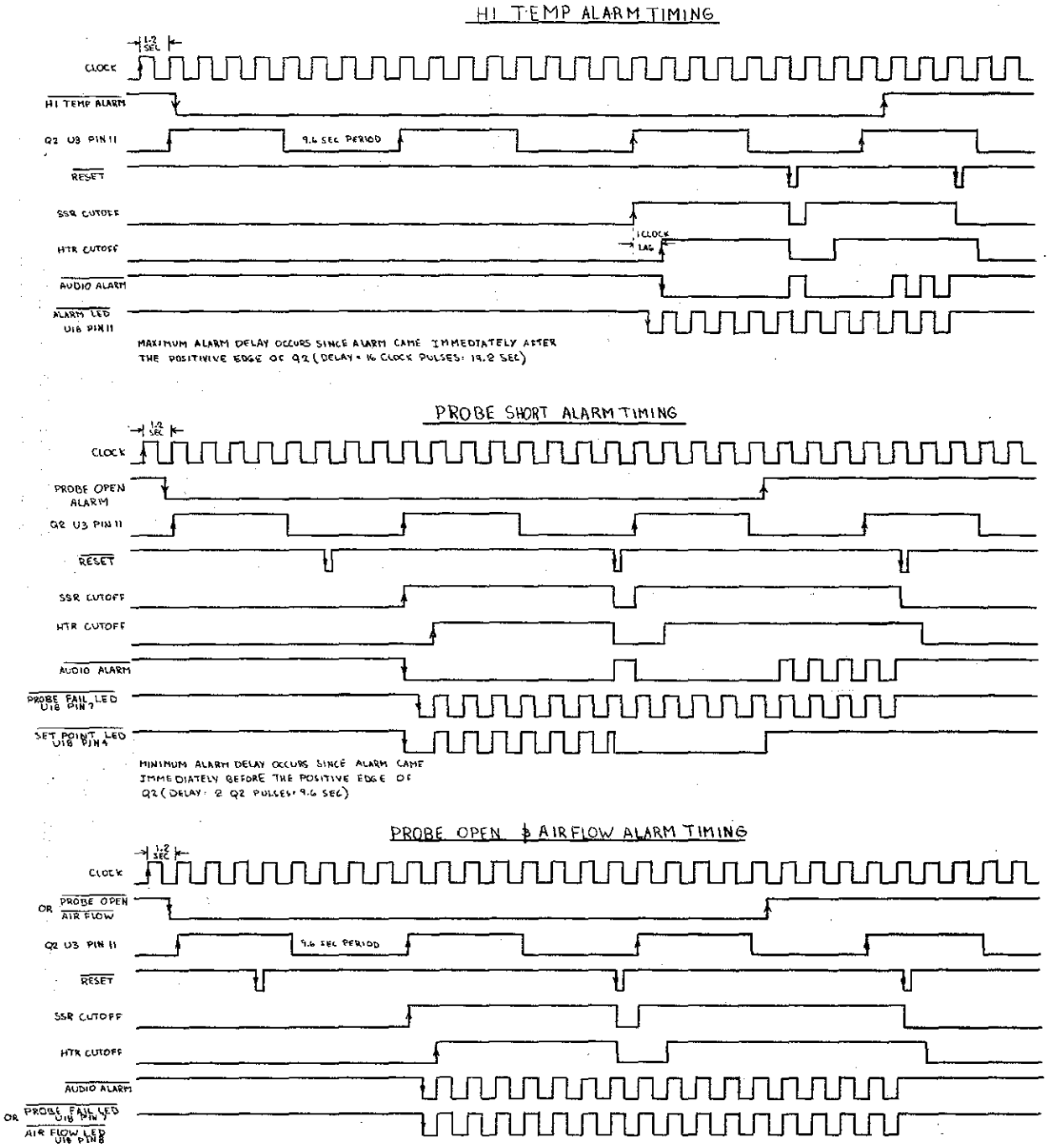
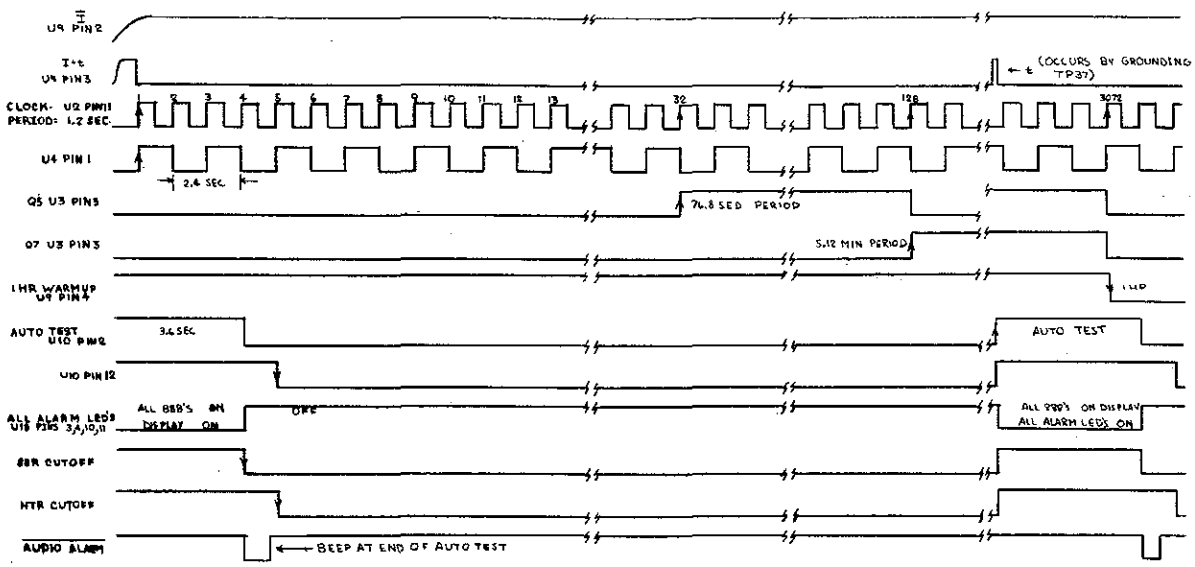
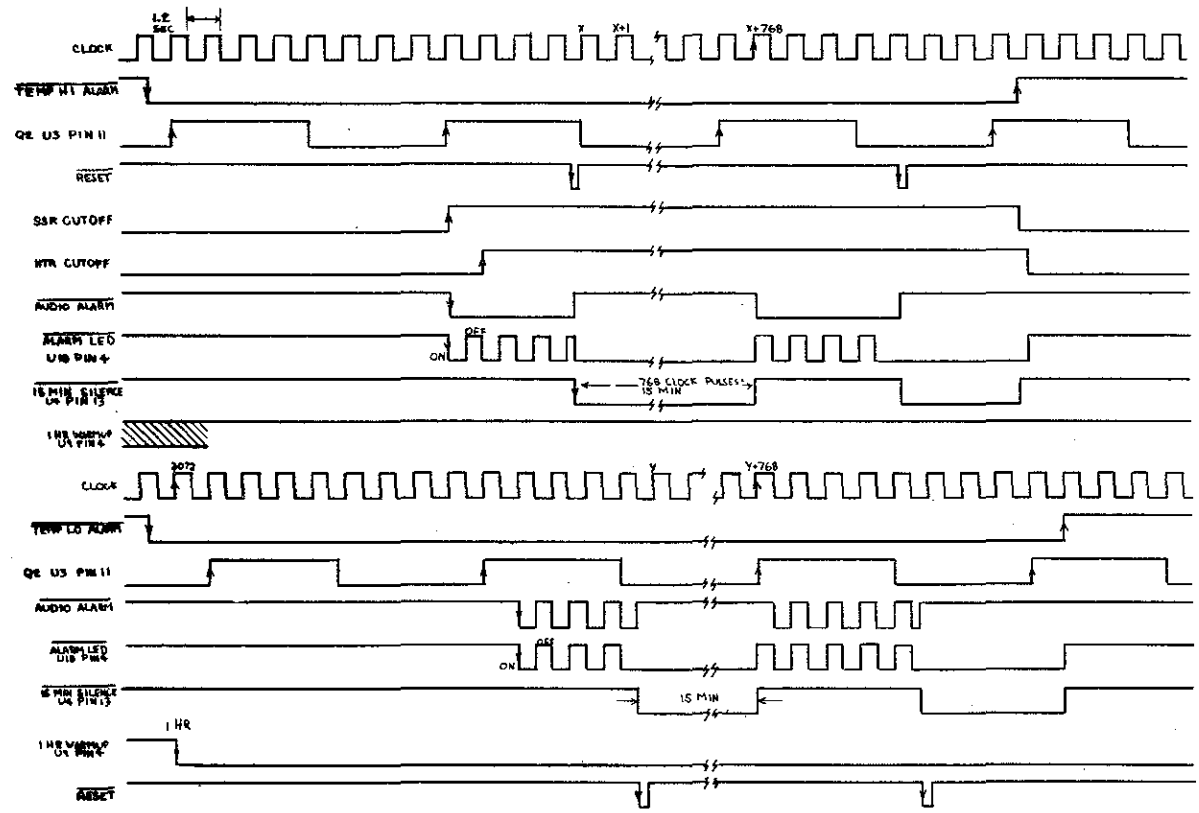

HI TEMP ALARM TIMING
1/2 SEC
CLOCK
HI TEMP ALARM
Q2 U3 PIN 11
9.6 SEC PERIOD
RESET
SSR CUTOFF
HTR CUTOFF
1 CLOCK LAG
AUDIO ALARM
ALARM LED U18 PIN 11
MAXIMUM ALARM DELAY OCCURS SINCE ALARM CAME IMMEDIATELY AFTER THE POSITIVE EDGE OF Q2 (DELAY = 16 CLOCK PULSES = 19.2 SEC)
PROBE SHORT ALARM TIMING
1/2 SEC
CLOCK
PROBE OPEN ALARM
Q2 U3 PIN 11
RESET
SSR CUTOFF
HTR CUTOFF
AUDIO ALARM
PROBE FAIL LED U18 PIN 7
SET POINT LED U18 PIN 4
MINIMUM ALARM DELAY OCCURS SINCE ALARM CAME IMMEDIATELY BEFORE THE POSITIVE EDGE OF Q2 (DELAY = 2 Q2 PULSES = 9.6 SEC)
PROBE OPEN & AIRFLOW ALARM TIMING
1/2 SEC
CLOCK
OR PROBE OPEN AIR FLOW
Q2 U3 PIN 11
9.6 SEC PERIOD
RESET
SSR CUTOFF
HTR CUTOFF
AUDIO ALARM
OR PROBE FAIL LED U18 PIN 7
AIR FLOW LED U18 PIN 8

FIGURE 3.14 CONTROLLER TIMING DIAGRAM (SHEET 1 of 2)

BASIC TIMING SIGNALS



SET POINT ALARM TIMING



NOTE: 1) SSR CUTOFF AND HTR CUTOFF ARE NOT EFFECTED DURING $\overline{\text{TEMP LO ALARM}}$

FIGURE 3.14 CONTROLLER TIMING DIAGRAM (SHEET 2 of 2)

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SECTION 4
PREVENTIVE MAINTENANCE

4.1 GENERAL

This section provides preventive maintenance procedures for the Incubator. Included are routine and special cleaning instructions, sterilization procedures, and a calibration schedule.

4.2 CLEANING

When an infant is discharged, or at least once a week, the Incubator should be thoroughly cleaned and disinfected. Cleaning can most effectively be accomplished by disassembling, then grouping the parts and/or assemblies in categories according to the method of cleaning required.

4.2.1 DISASSEMBLY FOR CLEANING

NOTE: For routine cleaning there is no need to separate the Hood/Base Assembly from the Cabinet Stand. If separation is necessary refer to the Installation Section.

> ***WARNING: The Controller heater can be sufficiently hot to cause burns; avoid removing the Controller or touching the heater until the unit has been switched off for at least 45 minutes.***

1. **REMOVE THE CONTROLLER.** Disconnect the Power Cord and Probe(s) from the side of the Incubator. Release the latch on each side of the Controller as shown in Figure 4.1, then withdraw the unit from the Incubator.

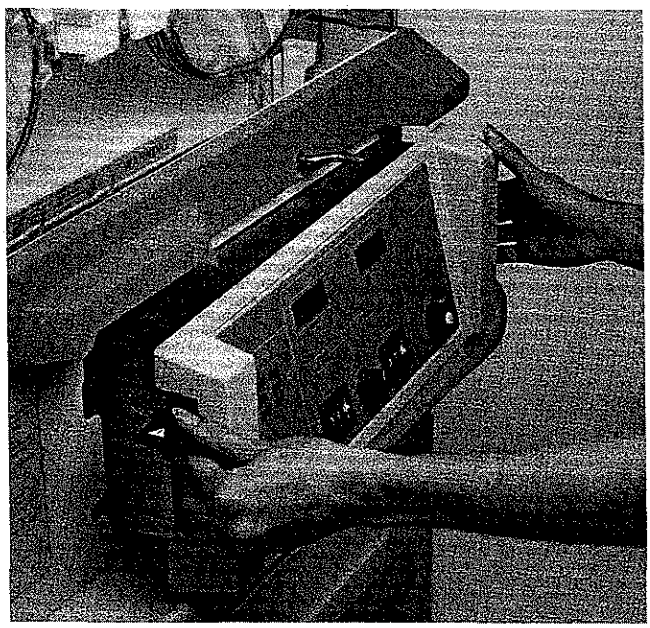

FIGURE 4.1 REMOVAL OF CONTROLLER

2. **REMOVE THE MATTRESS TILT MECHANISM (C100/200 QT™ Series –02 Incubators only)** by first loosening the two captive screws (Refer to Figure 4.2) that secure it to the Main Deck.

IMPORTANT: Both thumb screws must be fully tightened to ensure stable Mattress Tray support.

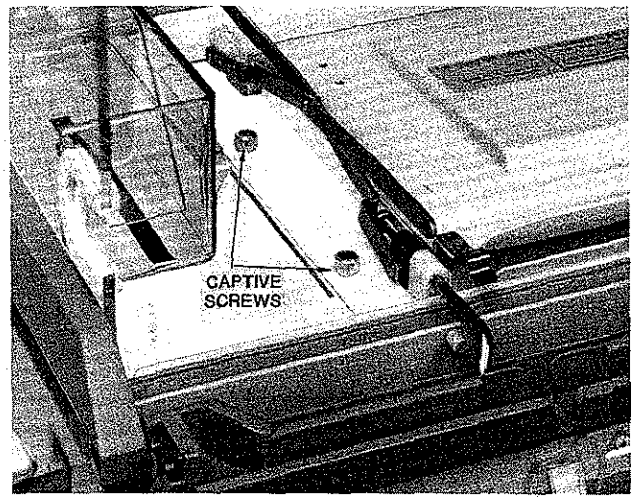

FIGURE 4.2 REMOVING THE MATTRESS TILT MECHANISM (C100/200 QT SERIES –02) INCUBATORS

3.* **REMOVE THE HOOD INNER WALL.** Remove the Inner Wall as described in Figure 4.3.

4.* **REMOVE ACCESS PANEL INNER WALL (HEAT SHIELD).** Refer to Figure 4.4. With the Access Panel completely open, remove the Inner Wall by simultaneously pulling out at the top and pushing in the downward direction.

5. **REMOVE MATTRESS TRAY AND AIR CURTAIN COVER.** Close the Access Panel and latch the Hood Assembly in the open position, then lift out the Mattress Tray. Remove and discard the disposable mattress cover. Lift the front of the Air Curtain Cover, swing it toward the back of the Incubator past the vertical position until you feel it snap free, then slide it slightly forward to remove.

* Double Wall Hood only.